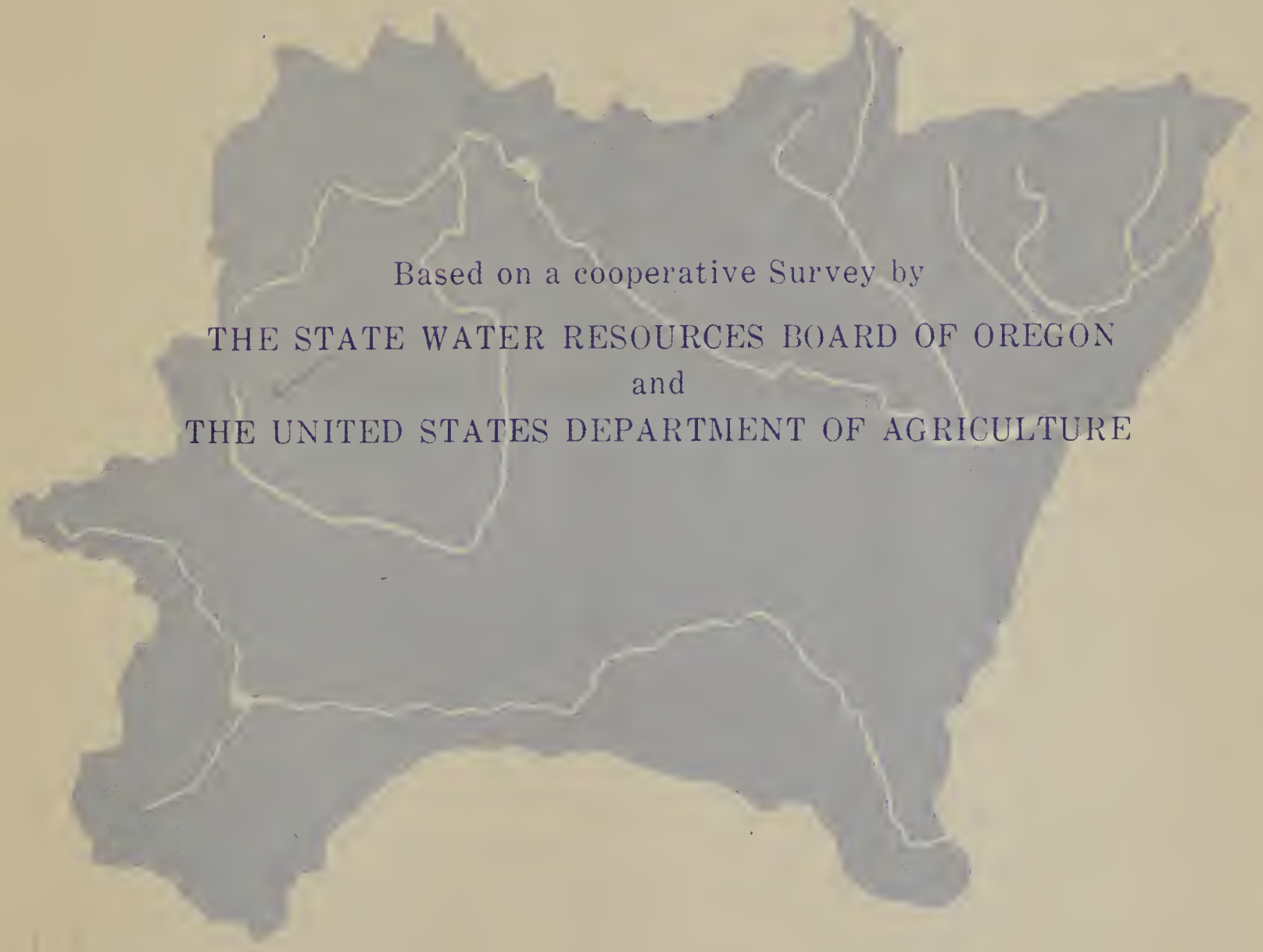
USDA Report on

WATER and RELATED LAND RESOURCES

POWDER DRAINAGE BASIN

OREGON



Based on a cooperative Survey by

THE STATE WATER RESOURCES BOARD OF OREGON

and

THE UNITED STATES DEPARTMENT OF AGRICULTURE

Prepared by · · ECONOMIC RESEARCH SERVICE · · FOREST SERVICE · ·
SOIL CONSERVATION SERVICE

January, 1966

M-4446

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January 1966

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INTRODUCTION

This report presents information concerning the water and related land resources of the Powder Drainage Basin. Its purpose is (1) to provide information on the past and present uses of water and related land resources; (2) to supply the production data from the use of these resources; (3) to assess the magnitude of water-related problems such as erosion, flooding, and drainage; (4) to indicate the probable direction of future use of water and land for agriculture and forestry in comparison to competing uses; and (5) to outline a general program for water and land resource management as a background for future detailed study and planning.

Anyone interested in land and water resources could benefit from the information in this report. The information could be of value to federal, state, and local agencies for planning and development of their various agricultural programs as they appraise the present and future uses of water for agriculture and forestry as compared to competing uses of water.

This study is a result of a cooperative agreement between the U. S. Department of Agriculture and the State Water Resources Board of Oregon and it is conducted under the provisions of Section 6 of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress, as amended).

The State Water Resources Board of Oregon is making a survey and an investigation of the Powder Drainage Basin to develop information needed for planning the coordinated development of the area's water resources. The information needed for its study includes: (1) the kind and location of desirable water resource developments; (2) the amounts of water required; (3) the physical opportunities for developments to meet water needs; and (4) the broad economic aspects of possible development. The State will use this information to formulate and to implement plans and programs to secure the most beneficial use and control of the area's water resources. The State's programs are intended, by legislative decree, to be dynamic in nature with provision for changes as new information is available and as the physical or economic situation changes. The current survey is only the beginning of the State's work in this area.

The survey consisted partly of accumulating and evaluating previously recorded data, both published and unpublished, much of which was furnished by other cooperating groups. In addition, the USDA River Basin Survey Staff made limited studies to gather basic information that was not otherwise available including physical characteristics of certain reservoir sites, land and

water availability and use, problems and needs for many tributary watersheds, and forest land resources and ownership. These were not detailed surveys; much of the information was obtained through consultation with local, public, and private officials. The basic data used as a foundation for statistical information presented in this report are in the files of the USDA River Basin Survey Staff.

Several agencies and organizations provided helpful assistance in making this survey. The field offices of the Soil Conservation Service furnished much of the basic information concerning reservoir sites and tributary watersheds. The County Extension Service and Agricultural Stabilization and Conservation Service assisted in the collection of tributary watershed data. Most of the land status information was obtained from County Assessor's records of the counties concerned. Much information on the forest land was furnished by the various field offices of the Forest Service, the Pacific Northwest Forest and Range Experiment Station, the Bureau of Land Management, and the State Forester of Oregon. Some of the agricultural data were obtained from publications of the Bureau of the Census. Several of these agencies also provided helpful consultation and comment concerning the preparation of this report. In accordance with the cooperative agreement, the State Water Resources Board developed and furnished information concerning existing water rights, major resources and their use, and other pertinent information in addition to furnishing hearing reports and maps.

SUMMARY

GENERAL DESCRIPTION OF THE BASIN

The Powder Drainage Basin, located in northeastern Oregon, contains 2,073,700 acres or 3.4 percent of the area in Oregon. The climate is temperate and semiarid being characterized by low precipitation, low winter temperature, and high summer temperature. The average frost-free season ranges from 60 days in the mountains to 200 days along the Snake River.

The basin is a part of the Blue Mountain geomorphic division of Oregon. Altered pre-Tertiary volcanic flows and sedimentary formations constitute the basement complex of the basin. Tertiary extrusions of rhyolite, andesite, and basalt cap the older formations at lower levels. Soils of the basin include those derived from mixed alluvium on flood plains, older terraces, alluvial fans, and lake basins and those formed from igneous or metamorphic rocks on uplands.

Settlement of the basin began in 1861 when gold was discovered. The completion of the railroad in 1885 gave further impetus to growth in the basin and population more than doubled from 1890-1900 and has remained at about the same level since 1900. The population of the basin in 1964 was 15,900 or about 1.9 percent of the state's population.

Agriculture soon became the major basic industry with lumbering and mining of industrial lime next. Construction, retail trade and services are the most important secondary industries. In recent years, the loss in employment in mining, agriculture, transportation, and communications has been offset by gains in employment in construction, the wholesale and retail trades, and services. Total employment has changed very little since 1940. The lack of sufficient job opportunities has led to out-migration of people, especially for those from 15 to 24 years of age.

Half of the land in the basin is federally owned, 2 percent is owned by state, county, and municipal governments, and 48 percent is privately owned. About 37 percent of the basin is forest land, 49 percent is rangeland, 9 percent is cropland, and the rest is in other uses.

FORESTRY IN THE BASIN

The forests are almost exclusively softwoods with small stringers of hardwoods in the valleys. The forest zone begins at about 4,000 feet above sea level. Ponderosa pine predominates in much of the forested area and often occurs in pure stands at lower elevations. Douglas-fir, white fir, western larch, lodgepole pine, and western white pine occur at higher elevations.

Problems associated with management of forest lands include damage from insects, disease, rodents, fire, and erosion. Fire protection is shared by the Federal Government, the State of Oregon, and rural fire districts.

Approximately 668,000 acres in the basin are classed as commercial timber land and support a stand of 6,408 million board feet of timber. An additional 5,000 acres with 61 million board feet of timber are classed as reserve commercial timber land.

Timber harvest began in the 1860's when logs and lumber were used locally for mining operations and buildings. The first shipment of lumber out of Baker County occurred in 1887 when 13 carloads of pine were shipped to Ogden, Utah. Logging operations at first concentrated in the ponderosa pine timber stands but since 1950 a significant amount of white fir, Douglas-fir, and other species have been harvested. Mills basically dependent on the basin for their supply of timber are located at Baker, Halfway, and Unity. These mills have a combined installed capacity of 80 million board feet per year.

Almost all cutover land in the basin has been logged by tractor. In the past, much damage to the watershed has resulted in areas of steep ground with erosive soil, particularly where skid roads were located and used without sufficient attention for protection.

The annual sustained-yield timber production of all commercial forest lands in the basin is expected to be between 80 million and 88 million board feet, depending upon the intensity of management that is achieved under both public and private ownership.

Recreational use of the forest land is of increasing importance. Use of forest lands for recreation is expected to increase by 500 percent from 1960 to the year 2000.

Water requirements for all areas on forest lands are expected to increase as the forest areas are used more heavily and managed more intensively. It is essential that all resource managers include control of erosion in their plan of management and that they think of water and soil as resources of value like trees and forage.

RANGE RESOURCES

Over 1,600,000 acres of the basin are devoted to range use. The range varies from open grassland in the streambottoms and meadows to rolling grass-shrub type to forested areas in the mountains. Both domestic stock and wildlife graze the range.

About 60 percent of the rangeland is publicly owned. Grazing on public land is controlled by issuing permits. The permits authorize a given number of animals on an allotted area for a specified period.

Range use started in the 1870's with the settlement of Baker Valley. The rangeland was overgrazed for several years which led to poor range conditions. In recent years, improved range management practices have restored some areas to a higher productive level but many areas remain at a low level of productivity.

A pilot project for range improvement has been started in the Keating area. Government agencies and ranchers are cooperating in a program which includes sage removal, seeding, and fencing.

AGRICULTURE IN THE BASIN

The dominant use of the land resource in the basin is for grazing. Forty-nine percent of the basin is classed as rangeland, 29 percent is grazed forest land and 7 percent is pasture or hayland. Livestock are grazed on rangeland or forested land for about seven months of the year and forage from hayland and pasture is used for winter feed and supplementary summer forage. The acreage in irrigated pasture has been increasing in recent years. Alfalfa, the major hay crop, is produced on about 33,000 acres of land. Forage production has become the major use of cropland for several reasons. The number of alternative crops that can be successfully grown is limited by a short growing season and limited rainfall. Irrigation is necessary to produce most crops. Forage crops are better adapted to the variable water supplies of the basin than most tilled crops. Forage crops are also favored by farmers from an economic standpoint because of the complementary relationship between the use of rangeland and the use of pasture and hayland.

Wheat and barley are the most widely grown tilled crops in the basin. Wheat was harvested from about 10,000 acres and barley was harvested from about 8,000 acres in 1964. Other crops grown in small quantity in the basin are sugar beets and potatoes.

The basin's agricultural land provides the forage base for 45,500 stock cows, 60,400 calves and feeders, 55,000 sheep, 2,700 milk cows, and 3,000 horses and mules. The general trend is for increased numbers of beef cattle and fewer milk cows, sheep, and horses.

Beef cattle accounted for about 59 percent of the gross agricultural income in 1959; sheep and wool accounted for 10 percent; and crops accounted for 24 percent. Dairy, swine, and poultry products accounted for the remaining 7 percent.

Irrigation began in the basin in the early 1870's and by 1919, 193,000 acres were irrigated. The water was over appropriated, and by 1929, the irrigated acreage decreased to about 135,000 acres and has remained at about that level since.

Since irrigation water is already often inadequate for the acreage developed for irrigation, any expansion of irrigation will require additional storage reservoirs, more efficient use of existing supplies, or importation of water.

WATER RELATED PROBLEMS, NEEDS, AND OPPORTUNITIES

Problems peculiar to the individual uses and management practices on crop, forest, and range lands influence the quality, quantity, and use of water. Water, in turn, influences all segments of the economy.

Average annual precipitation in the Powder Drainage Basin ranges from less than 10 to 80 inches, but less than 3 inches fall during June through September.

The total mean annual yield for this 2,073,700-acre basin is about 3,296,600 acre feet, while mean annual runoff (outflow) is around 753,600 acre feet.

Water requirements for the 162,300 acres of land developed for irrigation are approximately 730,400 acre feet, which is 97 percent of the estimated mean annual runoff. Estimates show an additional 92,600 acres of land that could readily be irrigated. This would require an additional 416,700 acre feet of water; therefore, for full development of the irrigation potential of the basin, importation of water from outside the basin will be required.

Normally, there is an adequate water supply for livestock and forest-related uses.

The main cause of flood waters in this basin is spring snowmelt. Most floods from snowmelt occur during March through June. Agricultural damages consisting primarily of crop and property losses account for much of the total evaluated flood damage; however, land damage from erosion and deposition is significant although it is difficult to evaluate and is probably inadequately appraised.

Irrigation is a major consumptive use of water in the basin. It has been developed by the efforts of both individuals and groups. Water is applied by both sprinkler and gravity systems.

Approximately 33,600 acres, or about 13 percent of the arable soils, have a major wetness problem.

Careful management of forest and range resources can result in maximum economic and social benefits without impairment of soil and watershed values; however, improper management of these resources can produce or intensify flood, erosion, and sedimentation problems.

The limited water in this basin should be developed to serve all phases of the economy. Surface water, ground water, and stored water can all be used to advantage to help meet the increasing water requirements of the area. There are many potential water storage sites, both large and small, that could be

developed for multipurpose use to aid in the future development and growth of the area. Thirty-seven sites of various sizes are pointed out in this report.

OPPORTUNITIES FOR WATERSHED PROTECTION AND FLOOD PREVENTION PROJECTS

The USDA River Basin Survey Staff made a study of the potential for P. L. 566 projects in the Powder Drainage Basin to provide information as a guide to long-range coordination and planning. The basin was divided into 16 tributary watersheds and a reconnaissance and summary report was made on each. It was concluded that seven projects appear to be feasible and that three projects might prove feasible but a more detailed study is required to make a decision. Two other watersheds have subareas that might prove feasible with more detailed study.

The watersheds with best possibilities for projects are those with a high potential for agricultural and/or urban development with localized flooding, drainage, and water supply problems that cannot be solved by individual action.

GENERAL DESCRIPTION OF THE BASIN

PHYSICAL FEATURES

Location and Size

The Powder Drainage Basin is located in northeastern Oregon (map 1). It is bounded by the Grande Ronde River Basin on the north, by the John Day River Basin on the west, by the Malheur River Basin on the south, and by the Snake River on the east. The basin has a total area of 2,073,700 acres--about 3.4 percent of Oregon. It contains almost all of Baker County, about 1.3 percent of Union County, and minor portions of Wallowa and Malheur Counties. Two major stream systems and two minor streams comprise the drainage system; these are the Powder and Burnt Rivers and the Pine and Benson Creeks. The Powder River has a remarkable S-shaped, curved course heading in the mountains above Sumpter and flowing southeastward through the Sumpter Valley then northward and northwestward through the Baker Valley and the North Powder Valley and then flowing southeastward for nearly forty miles to the Snake River. Burnt River heads in the Unity and Whitney area and flows mostly eastward to Durkee and then southeastward to the Snake River. Pine Creek in the northeast section of the basin flows southeastward and then northeastward to enter the Snake River near Copperfield. Benson Creek in the southeast section flows east about seven miles to enter the Snake River south of Huntington.

For the purpose of this report, the Powder Drainage Basin has been divided into sixteen watersheds. These watersheds vary in size from 15,900 acres to 220,700 acres.

Climate

The climate of the Powder Drainage Basin is temperate and semiarid being characterized by low precipitation, low winter temperature, and high summer temperature. The topography of the basin produces considerable local variation in the climate.

The average annual precipitation ranges from 80 inches in the area of Eagle Cap to 8 inches in the Haines area of the Baker Valley (map 2). Annual precipitation in the cropland areas is generally less than 20 inches. Only about 25 percent of the precipitation falls during the irrigation season--April through September. During the summer months, much of the basin is subject to violent convection (cloudburst) storms of small areal extent and high

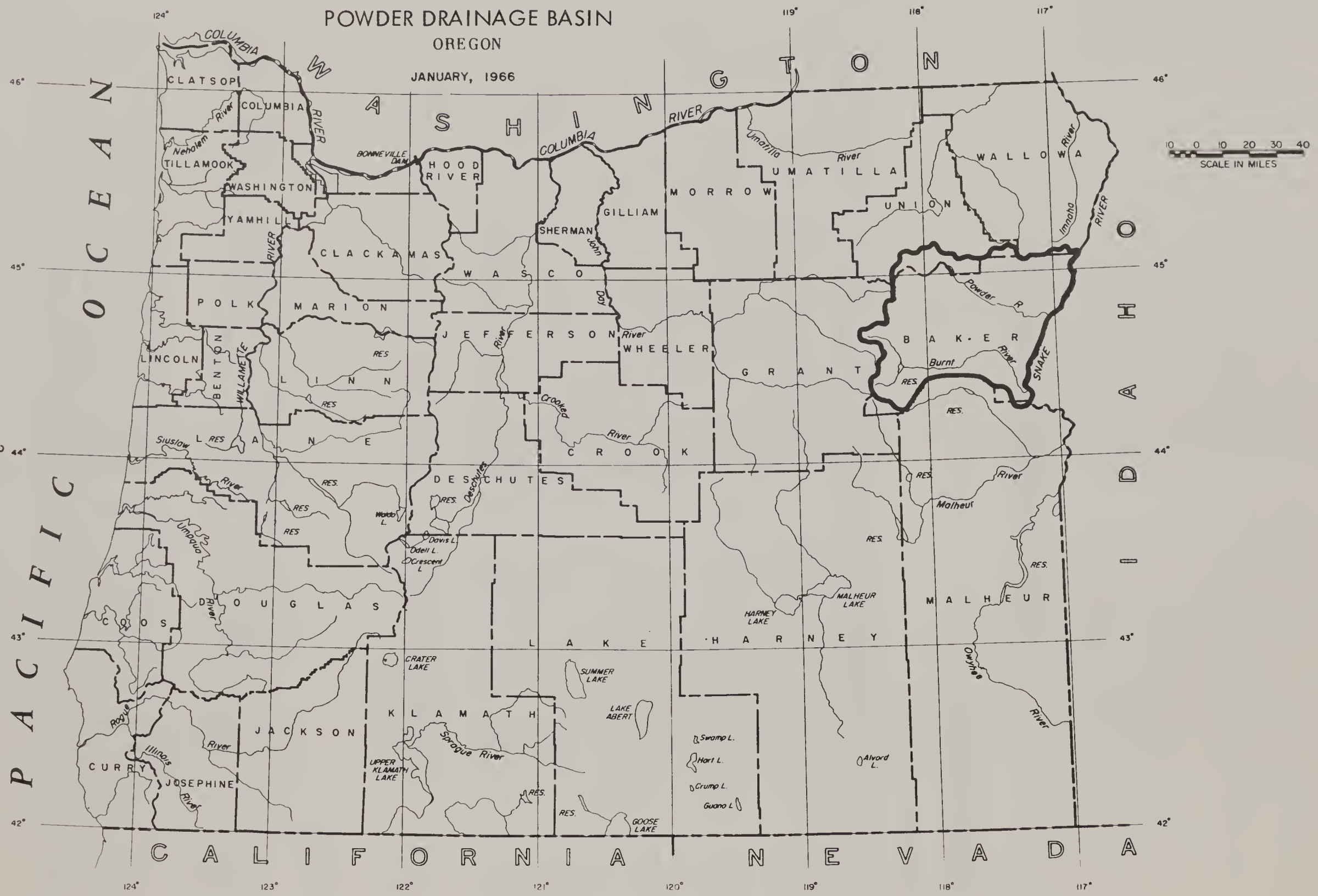
MAP 1

LOCATION MAP

POWDER DRAINAGE BASIN

OREGON

JANUARY, 1966



WATERSHEDS

14-3	Oxbow
14-4	Pine Valley
14-5	Home
14-6	Benson Creek
14u-1	Eagle Valley
14u-2	Big Creek
14u-3	Lower Powder
14u-4	Wolf Creek
14u-5	North Powder
14u-6	Sumpter Valley
14u-7	Baker
14t-1	Durkee Valley
14t-2	Lower Burnt
14t-3	Middle Burnt
14t-4	Whitney
14t-5	Unity

Source U.S. WEATHER BUREAU

LEGEND

- 20 — Normal Annual Precipitation in Inches
- Drainage Basin Boundary
- 14u-2 — Watershed Boundary and Numbers
- National Forest Boundary

DRAINAGE BASIN LOCATION

COUNTY LOCATION

MAP 2

PRECIPITATION MAP
POWDER DRAINAGE BASIN
OREGON

JANUARY 1966

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SCALE IN MILES

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intensity. These storms are the cause of severe soil erosion and flood damage and they increase the soil moisture very little.

The annual snowfall varies from a trace along the Snake River to several feet in the upper reaches of the basin. Mountain snowpacks are important sources of water for irrigation, fishlife, wildlife, domestic use, and other uses. The mean annual snowfall is 35.2 inches at Baker and 294.4 inches at Cornucopia in the Wallowa Mountains.

The prevailing winds are northwest in the summer and southeast the remainder of the year. The wind velocity usually ranges from 6 to 8 miles an hour, with the highest velocities in December, January, and February. High winds and tornado-like storms are rare in the area and the velocity very seldom exceeds 40 miles per hour.

The mean annual temperatures in the cropland areas vary from 44 degrees at Baker to 53 degrees at Huntington. Average temperature extremes vary from -30 degrees at Baker to 110 degrees at Huntington.

The average growing season ranges from 60 days in the mountains to 200 days along the Snake River. The average frost-free season at different locations are as follows: Baker, 140 days; Richland, 130 days; Sparta, 160 days; and Huntington, 180 days.

Geology

The Powder Drainage Basin is a portion of the Blue Mountain geomorphic division of Oregon. Altered pre-Tertiary volcanic flows and sedimentary formations, which were intruded extensively by dioritic and granitic rocks, constitute the basement complex of the basin and are exposed at higher elevations. Tertiary extrusions of rhyolite, andesite, and basalt cap the older formations at lower levels. Sediments of Tertiary and Quaternary age were deposited as terraces, lake beds, and valley alluvium. The generalized geologic map (map 3) and the narrative portion illustrate and describe the topography, structure, and rock formations.

Topography and Structure. The Blue Mountain uplift and the Wallowa Mountain uplift comprise mountainous topography in the western and the northern sections, respectively, of the basin. The area that joins the mountains includes the remainder of the basin and could have been, originally, an eastward sloping plateau. The higher portion of the plateau is a dissected plateau; whereas, in the lower portion, the forces of erosion and of mass movement have removed the original surface and have developed a mature topography. The drainage systems of the Powder and Burnt Rivers and Pine and Benson Creeks have imposed themselves upon this secondary surface. The valleys through which these streams flow alternate between broad, nearly level to gently sloping sediment basins with shallow meandering stream channels to narrow, tortuous canyons with narrow, steep stream channels. Elevations vary from 9,595 feet on Eagle Cap in the Wallowa Mountains and 9,105 feet on Rock Creek Butte in the Blue Mountains to 3,330 feet in the Baker Valley and to approximately 1,650 feet near Homestead along the Snake River.

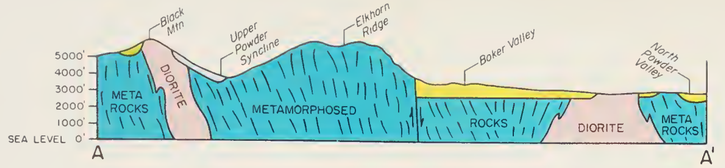
Glacial action and other kinds of erosion have sculptured the mountains into an intricately precipitous topography with many cliffs and pinnacles. The numerous cirques, small glacial lakes, steep-walled, U-shaped valleys, and morainal and outwash deposits are the result of glacial action. Almost all the country above 8,000 feet and smaller areas several hundred feet lower are nearly free of soil. A large number of the valleys which head at the higher altitudes begin in rock-floored basins containing lakes.

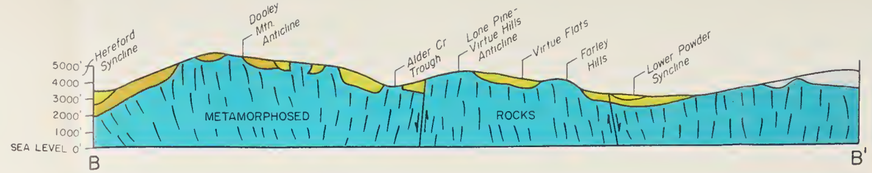
The lower section of hills varies in elevations from 5,000 to 6,000 feet to approximately 2,000 feet. Broad, dissected, upland plateau surfaces are common in the higher area and the physiography of the area lying at less than 4,000 feet is round- to flat-topped hills with steep sides and terrace-like areas between them at different elevations. The streams in the upper levels flow all year but the ones at lower elevations flow intermittently.

The Snake River, the eastern boundary of the basin, has entrenched itself in the rock formations. Its flood plain is almost completely inundated by the reservoirs. Two major and two minor drainages dissect the plateau section. Some sections of the valleys are youthful in development and the streams flow rapidly through V-shaped canyons or gorges and leave only a minimum of flood-plain deposition. In contrast, other sections of the valleys are filled with up to 1,000 feet of sediment and are broad and nearly level to gently sloping with meandering streams of low to moderate gradient. In Baker Valley, the largest of these valleys, the west side of the valley floor has been covered by an east-sloping alluvial fan which is 700 feet deep where it joins the uplands on the west.

Considerable distortion, shifting, and movement in the earth's crust occurred in pre-Tertiary time; however, except for the Blue Mountain and Wallowa Mountain uplifts, the present topography is controlled by late Tertiary to Pleistocene events which included a tremendous amount of block faulting and intense folding. The Elkhorn Mountains extending westward from Baker into the Blue Mountains were formed by folding or uplifting which was augmented by the batholithic intrusion of the Bald Mountain granodiorite. The Dooley Mountain Anticline, the Hereford Syncline, and another major anticline paralleling them on the south compose a series of folds or an anticlinorium. The Hereford Syncline forms the valley for Burnt River. The structure of the valleys is either synclines, down-dropped faults, blocks, or narrow gorges that have been carved through uplifted, erosion-resistant rocks. The Snake River was probably located at the eastern edge of the Columbia River basalt extrusion and continued there as the surface was uplifted during Pliocene and Pleistocene time.

Metamorphosed Sedimentary and Igneous Rocks. These pre-Tertiary rocks are exposed in the Wallowa and Blue Mountains, the central section of the basin, the Durkee and Huntington area, and along the Snake River. The original material included a thick and varied series of marine sediments, small amounts of fresh or brackish water sediments, lavas, volcanic tuffs, and igneous intrusives, principally gabbro. These rocks were profoundly transformed by the metamorphic processes of tremendous heat and pressure. These formations date to the Permian period of the Paleozoic era and extend to the Triassic period of the Mesozoic era.





GENERALIZED GEOLOGIC CROSS SECTIONS

DRAINAGE BASIN LOCATION

COUNTY LOCATION

WATERSHEDS

14-3	Oxbow
14-4	Pine Valley
14-5	Home
14-6	Bensan Creek
14u-1	Eagle Valley
14u-2	Big Creek
14u-3	Lower Powder
14u-4	Wolf Creek
14u-5	North Powder
14u-6	Sumpter Valley
14u-7	Baker
14t-1	Durkee Valley
14t-2	Lower Burnt
14t-3	Middle Burnt
14t-4	Whitney
14t-5	Unity

LEGEND

PLEISTOCENE TO RECENT
- Fluviatile and Glacial Deposits

TERTIARY
- Lake Beds and Related Sediments
- Basalts and Basaltic Andesites
- Rhyolite and Related Volcanics

PRE-TERTIARY
- Diorite and Related Intrusives
- Metamorphosed Sedimentary and Igneous Rocks
- Anticline Axis
- Syncline Axis
- Fault Traces (hachures indicate downdrop side)
- Drainage Basin Boundary
- Watershed Boundary
- National Forest Boundary

DATA SOURCE
U.S. Geological Survey.
Oregon State Dept of Geology and Mineral Industries.

MAP 3

GENERALIZED GEOLOGIC MAP
POWDER DRAINAGE BASIN
OREGON

JANUARY 1966

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SCALE IN MILES

U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE · SCS-ECS PORTLAND, OREG. 1966 M-4446

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Greenstone, quartz, and conglomerate schist, limestone, slate, and quartzite more than 20,000 feet thick make up the Burnt River schist of the Permian period. The Elkhorn Ridge argillite of Permian age is composed of argillite (compacted and silicified mudstone), tuff, chert, and some limestone and greenstone and it is dark-gray, almost black, and with little or no bedding. The Clover Creek greenstone formation is altered volcanic flows and pyroclastic rocks and a smaller amount of conglomerate, limestone, and chert. It was extruded into the sea and deformed while being uplifted.

Overlying the Paleozoic metamorphic formations are thick sections of sedimentary and volcanic rocks of Triassic age. In the southern portion of the basin, two series of these rocks have been recognized. The older of these two series may be equivalent to the Martin Bridge formation of the Wallowa Mountains. This formation is composed of greenstone, rhyolitic flows, sandstone, and slaty siltstone and is exposed at Huntington and along the Snake River to the north. The younger section is a thick section of sedimentary rocks of purple and green phyllonite which grades upward into shale, siltstone, and limestone. Limestone is quarried from these beds near Lime for cement and gypsum has been mined from them along the Snake River north of Huntington. The Triassic rocks in the Wallowa Mountains are: the formation referred to as "Lower Sedimentary Series"; the Martin Bridge limestone which has been altered to marble along the edge of the Wallowa batholith; and the Hurwal formation--a series of argillaceous beds.

Ground water is limited in these beds and only small quantities have been recovered.

Diorites and Related Intrusives. Almost all pre-Tertiary rocks are of the Cretaceous period. Portions of the Elkhorn Range, Blue Mountains, and Wallowa Mountains are composed of these formations. These light-colored rocks, which are commonly called "granites", are not true granites but are tonalities, diorites, granodiorites, and quartz diorites. This material was intruded as batholiths or stocks into the older Paleozoic beds. The mineralization accompanying these intrusions probably produced most of the lode gold and other minerals; therefore, the early mining towns and mines are located near the contact bordering these intrusions or in the alluvial plains in which material from these rocks was deposited. Some of the early history of this part of the state is involved with the mining camps of Sumpter, Granite, Bourne, Copperfield, Whitney, et cetera. Large areas of the Sumpter and nearby valleys were dredged for gold until the time of World War II when they were closed by government order.

Only negligible amounts of ground water have been recovered from these rocks.

Rhyolites and Related Volcanics. Large areas of these materials are found in the southwestern portion of the basin. The upland between the Powder and the Burnt Rivers in the upstream portion of the drainages is composed of these volcanic rocks--rhyolites, dacites, andesites, and their related porphyries, tuffs, tuff breccias, and agglomerates. Dooley Rhyolite breccia is the name given to one of the formations of this material and it is believed that similar rocks in the area to the west are known as the Clarno and John Day series.

Only small amounts of ground water exist in these rocks.

Basalts and Basaltic Andesites. The most widespread geologic formation in northeastern Oregon is Columbia River basalt, an extrusion during middle Miocene time. These rocks cover a large area in the northern and eastern sections of the basin and small areas appear as "table tops" capping softer rocks in other sections of the basin. The extrusion probably covered most of the Blue and Wallowa Mountains at one time and still is present in isolated locations as remnants. This formation is made up of many lava flows of dark-gray to black, dense, very fine-grained basalt piled to thicknesses as great as 2,000 feet. Younger flows of Pliocene and Pleistocene age also were deposited in smaller areas of the basin.

The porous zones of these volcanic rocks should be productive aquifers of ground water and even the denser phases may be producers of water. A small to moderate supply of water might be expected from these formations.

Lake Beds and Related Sediments. After the last Miocene extrusion of rock formations, sediment was deposited over much of the area in shallow, fresh-water lakes and flood plains in Pliocene time. These sediments are known as the Idaho formation. A large portion of the basin was probably at relatively low relief during the time of sedimentation and this allowed the sediments to be spread over large areas. Considerable block faulting and folding have changed the vertical location since they were deposited. These sediments underlie younger sediments in the valleys; exist on terraces in intermediate elevations; and lie on higher locations in the uplands. Faulting has interrupted the continuity of these beds on terraces and uplands. On the uplifted parts, a large portion of the sediments has been eroded away. The deposits are composed of silts, muds, sands, pebbles, and boulders and, in places, contain extensive quantities of diatomite and volcanic ash and small amounts of poor-grade coal. Because these sediments are not well consolidated, they erode quite easily.

The quantity of ground water encountered in these sediments varies from small to moderate depending on the loss by seepage.

Fluviatile and Glacial Deposits. Fluviatile deposits are found along the streams and in the fault-dropped basins. The narrow flood plains through the gorge-like areas are shallow and are composed of coarse material. The broad valleys are filled with up to 1,000 feet of gravel, sand, silt, and clay which were eroded from metamorphosed sedimentary and igneous rocks, diorite, rhyolite, basalt, andesite, and related volcanics. Bedrock or the sediments of the Idaho formation underlie these younger sediments. Gold-bearing gravel which was eroded from the lode deposits of the nearby mountains was deposited in the alluvium of many basins including Sumpter Valley. Glacial deposits remain as moraines and outwash along the valleys down which the glaciers flowed. Large alluvial fans were formed by outwash deposits in the valleys. A notable one is located along Rock Creek in Baker Valley.

The major part of the ground water now being used is withdrawn from these unconsolidated sediments. The upper surface of the ground water supply comprises the regional water table of the valleys and conforms generally to the surface of the land. A moderate to large supply is available for irrigation wells.

Soils

Three general groups of soils exist in the Powder Drainage Basin. The soils were produced by weathering forces acting on the parent material at any given point on the surface of the earth. The characteristics of the soils are determined by the combination of five factors: geologic, source and kind of parent and underlying material; physiographic, kind and shape of land form; meteorologic, temperature and precipitation; organic, dead and living animal and plant life; and time, relative age and development of the soils. The area of each of these groups of soils is delineated on the generalized soil map (map 4). The narrative contains a general description of each group. Table 1 lists the soil groups and the soil series in each group and describes some of the prominent characteristics and qualities.

Soils of Bottom Lands and Recent Alluvial Fans Formed from Mixed Alluvium. The deposits of alluvium on the flood plains, alluvial fans, and lake basins originated in the surrounding mountains, hills, and high terraces. These areas of soils cover approximately 5 percent of the basin. The parent material of mixed mineralogy was weathered from metamorphosed sedimentary and igneous rocks, diorite, rhyolite, basalt, andesite, and related volcanics. The physiography of these soils is wide flood plains or lake basins in the wide sections of the valleys and narrow flood plains in the steep, canyon-like sections of the valleys. Alluvial fans have formed over the top of the older material in some of the basins.

Weak to moderate development and medium to fine textures characterize the profiles of these soils. The depth varies from shallow and moderately deep with a restricting layer of either gravel or hardpan to very deep. The slopes are nearly level--0 to 2 percent--on the alluvial plains and old lake basins and nearly level to sloping--0 to 12 percent--on the alluvial fans.

The largest areas of these soils produce crops and smaller areas produce range and forest. The poorly drained Baldock, Haines, Stanfield, and Umapine are moderately to strongly affected by salts and alkali. About 60 percent of these soils are vegetated with native saltgrass; however, they could be reclaimed by drainage and irrigation. The group of somewhat poorly to poorly drained soils, Balm, Hershal, Robinette, and Wingville, has been drained and the surface waters controlled which enables them to grow hay, pasture, and row crops. Grain is grown on the Wingville soil. The well drained soils, Powder, Goodrich, Jett, and Langrell, produce grain, row crops, hay, and pasture. In Pine Valley, corn is grown on the Langrell soils.

Soils of Older Terraces, Alluvial Fans, and Lake Basins Formed from Mixed Materials. Almost a fourth of the basin is occupied by this group of soils. These soils were developed in mixed material of the Idaho formation which was eroded from the surrounding hills and deposited in shallow, freshwater lakes and flood plains in late Miocene or Pliocene time. The sediments are materials that were weathered from metamorphosed sedimentary and igneous rocks, diorite, rhyolite, basalt, andesite, and related volcanics. Structural changes have rearranged the topographic position of this alluvial plain. A portion remains in its original position, a portion was lowered and buried by younger sediments, and a third portion was uplifted and the sediments eroded away.

These soils are strongly developed and possess medium to fine textured profiles. Depth varies from very shallow to very deep and the restricting layer in the soils less than 60 inches deep is composed of either clay, gravel, or hardpan. The slopes on the terrace surfaces are nearly level to strongly sloping to steep with slopes from 16 to 40 percent. This group of soils is neutral in reaction in the surface and has lime accumulation in the substratum.

The major area of land on the terraces at the lower elevations produces crops and the area at higher elevations produces range. In the Sumpter and Whitney Valleys, the McEwen soils produce mainly forest; however, small areas have been cleared and grow crops. The crops that are grown include grain, hay, pasture, and row crops such as potatoes and corn.

Soils of the Uplands. The upland soils occur in almost 70 percent of the basin. The topography in the higher elevations is mountainous and is characterized by a dendritic pattern of drainages. The area below 4,000 to 5,000 feet elevation is partly mountainous terrain and partly round- to flat-topped hills with steep to very steep sides intermixed with flat terrace areas. This group of soils may be divided into three subgroups on the basis of parent and underlying material. Soils from the different parent materials generally occur in an intermixed pattern and not in large, contiguous bodies. They are well drained and are neutral to slightly acid in the surface. This land is used for cropland, range, forest, recreation, wildlife habitat, and water supply.

Approximately 23 percent of the upland soils were formed from acid igneous rocks. The soils have moderately developed and medium to moderately fine-textured profiles. Depth varies from shallow to deep to bedrock. The slopes are nearly level to hilly--1 to 30 percent--with the breaks being steep--20 to 48 percent. Most of the North Powder and Brownlee soils are in high producing range. Small portions of the North Powder soil are farmed, some with irrigation; and small areas of the Brownlee soil were homesteaded and dryfarmed but they are now reseeded to range. Kilmerque is mostly in forest, part of which is grazed, and small spots have been cleared for cropland use.

Approximately 50 percent of the upland soils were developed from basic igneous materials. These soils have weakly to strongly developed and medium- to fine-textured profiles. Depth varies from very shallow to very deep. The slopes vary from nearly level to very steep--0 to 45 percent. Bakeoven, Glasgow, Lookout, Rock Creek, and Ruckles produce range, and Hall Ranch and Klicker produce forest. Mehlhorn grows both range and forest, and Tolo grows both forest and cropland. A portion of the forest land is used for grazing.

Approximately 27 percent of the upland soils were formed from metamorphic rocks. These soils have moderately and strongly developed, medium- to fine-textured profiles with a variation in depth from very shallow to deep. Durkee and Keating soils produce range; however, some areas were homesteaded, farmed, and later reseeded. The Rouen soil produces forest, some of which is grazed.

WATERSHEDS

14-3	Oxbow
14-4	Pine Valley
14-5	Home
14-6	Benson Creek
14u-1	Eagle Valley
14u-2	Big Creek
14u-3	Lower Powder
14u-4	Wolf Creek
14u-5	North Powder
14u-6	Sumpter Valley
14u-7	Baker
14t-1	Durkee Valley
14t-2	Lower Burnt
14t-3	Middle Burnt
14t-4	Whitney
14t-5	Unity

LEGEND

- Soils of Bottom Lands and Recent Alluvial Fans
- Soils of Older Terraces, Alluvial Fans and Lake Basins
- Soils of Uplands
- Drainage Basin Boundary
- Watershed Boundary
- National Forest Boundary

DRAINAGE BASIN LOCATION

COUNTY LOCATION

MAP 4

GENERALIZED SOIL MAP
POWDER DRAINAGE BASIN
OREGON

JANUARY 1966

SCALE IN MILES

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE 1966 SCS PORTLAND, OREG. M-4446

7-E-17866-N

Table 1.--Characteristics, qualities, and other data of soils, Powder Drainage Basin, Oregon, 1966 1/

Soil groups	Classification		Texture surface soil	Reaction surface soil	Texture subsoil	Restrictive layer		Drainage class	Permeability	Water-holding capacity	Infiltration	Suitability for irrigation	Major land use	Special problems	Elevation	Precipitation	Growing season	Annual mean temperature
	Sub-groups	Family				Kind	Depth											
				pH value			Inches			Inches/foot					Feet	Inches	Days	
Soils of bottom lands and recent alluvial fans formed from mixed alluvium:																		
Baldock	Typic Haplothent	Fine, loamy, mixed, calcareous, mesic	Silt loam to silty clay loam	7.6-9.0	Silt loam to silty clay loam	Sand or gravel	36	Somewhat poorly to poorly	Moderate	2.0-2.2	Medium	Fair	Cropland	Drainage, salinity and alkalinity	2000-3800	9-13	120-150	47
Balm	Aquic Haplustoll	Coarse loamy, mixed, mesic	Loam to gravelly loam	7.4-8.3	Gravelly loam	Gravel	16-26	Poorly	Moderate	1.7	Medium	Fair	Cropland	Drainage	2200-3000	9-13	110-130	48
Goodrich 2/	Entic Haplustoll	Coarse silty, mixed, mesic	Silt loam to gravelly loam	6.9-7.4	Silt loam to gravelly loam	Sand and gravel	30-48	Well	Moderate	1.7-2.0	Medium	Good	Cropland	Gravel substratum	2700-3500	9-13	110-130	47
Haines	Ochric Andaquept	Ashy, calcareous, mesic	Silt loam	9.6	Silt loam	None	60	Somewhat poorly to poorly	Moderate	2.2	Medium	Fair	Cropland	Drainage and alkalinity	2700-3400	11-13	110-120	47
Hershal	Haplic Cryaquoll	Coarse silty over sandy skeletal, mixed, non-calcareous	Silt loam	6.5-7.0	Silt loam	Gravel	24-40	Somewhat poorly to poorly	Moderate	2.0	Medium	Good	Cropland	Drainage	3800-4200	17-22	90-100	43
Jett 2/	Cumulic Haplustoll	Coarse silty, mixed, mesic	Silt loam to silty clay loam	7.6-8.2	Silt loam	None	60+	Well	Moderate	2.0-2.2	Medium to slow	Good	Cropland	None	3400-4200	11-14	105-115	47
Langrell	Cumulic Haploxeroll	Coarse loamy, mixed, mesic	Loam to gravelly or cobbly loam	6.8-7.2	Loam to gravelly or cobbly loam	Sand or gravel	16-36	Well	Moderate	2.0	Medium	Good	Cropland	Shallowness	2500-3100	17-22	110-120	48
Powder	Andic Aridic Entic Haplustoll	Coarse silty, mixed, mesic	Silt loam	6.8-9.0	Silt loam	Gravel	30-60+	Well to moderately well	Moderate	2.2	Medium	Good	Cropland	None	2700-3500	9-13	100-145	47
Robinette 2/	3/	3/	Silt loam	6.8-7.2	Loam	Gravel	16-32	Poorly	Moderate	2.0	Medium	Fair	Cropland	Drainage	2300-3600	18-22	110-120	47
Stanfield	Mollic Durorthid	Coarse silty, mixed, mesic	Silt loam	9.0-9.8	Silt loam	Calcareous hardpan	18-26	Somewhat poorly to poorly	Moderately slow	2.0	Slow	Poor	Cropland	Drainage and alkalinity	2700-3500	9-13	120-135	46
Umapine	Andic Haplorthent	Coarse silty, mixed, calc., mesic	Silt loam	8.5-9.4	Silt loam	None	60	Somewhat poorly	Moderate	2.0	Medium	Fair	Cropland	Drainage and alkalinity	2700-3500	9-13	120-135	46
Wingville	Andic Cumulic Haplaquoll	Fine silty, mixed, calc., mesic	Silt loam to silty clay	7.0-8.5	Silt loam to silty clay loam	Gravel	30-36	Somewhat poorly to poorly	Moderately slow	2.0-2.2	Medium to slow	Good	Cropland	Drainage	2300-3600	10-14	110-120	47
Soils of older terraces, alluvial fans, and lake basins formed from mixed materials:																		
Applegate	Typic Durixeroll	Fine, mixed, mesic	Clay loam	6.6-7.0	Stony clay	Silica hardpan	30-42	Well	Moderate	2.0	Medium	Good	Cropland	Erosion on steeper slopes	2700-3400	18-23	100-110	48
Baisley 2/	3/	3/	Silt loam	6.6-7.0	Silty clay loam to clay	Silica calcareous hardpan	26-36	Well	Moderate	2.0	Medium	Good	Cropland	Erosion on steeper slopes	2700-3600	11-14	110-120	47
Baker	Haplic Durustoll	Coarse loamy, mixed, mesic	Silt loam	6.8-7.8	Silt loam	Hardpan	24-36	Well	Moderate	2.0	Medium	Good	Cropland and range	Erosion on steeper slopes	2600-4000	9-13	100-130	47
Barnard	Typic Durustoll	Fine, montmorillinitic, mesic	Loam to clay loam	7.0-7.5	Silty clay loam to clay loam	Hardpan	12-24	Well	Moderate	2.0	Medium	Fair	Cropland and range	Shallowness	2300-3200	9-13	110-125	49
Bourne 2/	3/	3/	Very stony loam	6.2-6.6	Stony clay	Gravel	6-10	Well	Slow	0.8	Slow	...	Range	Shallowness and stoniness	3800-4400	17-22	90-100	43
Encina 2/	Typic Argiustoll	Fine loamy, mixed, mesic	Silt loam to clay loam	6.6-7.0	Clay loam	Gravel	20-30	Well	Moderately slow	1.8	Medium	...	Range	Erosion on steeper slopes	3200-4500	10-14	100-130	47
Halfway	Typic Grumqauert	Mesic	Silty clay loam	6.8-7.2	Clay	Clay	30	Moderately well	Slow	2.4	Slow	Poor	Cropland	Fine textured subsoil	2700-3400	17-22	100-120	48
Hutchinson	Typic Durustoll	Fine, montmorillinitic, mesic	Silt loam to gravelly silt loam	6.6-7.0	Clay	Hardpan	20-36	Well	Moderate	2.0	Medium	Good	Cropland and range	Erosion on steeper slopes	3400-4000	13-16	90-110	45
Ladd	Typic Argixeroll	Fine loamy, mixed, mesic	Loam to silt loam	6.6-7.0	Clay loam	None	60+	Well	Moderate	1.8	High	Good	Cropland	Erosion on steeper slopes	3400-4200	13-16	100-120	46
McEwen	Eutrandeptic Normudalf	Fine loamy, mixed, frigid	Silt loam to very stony silt loam	6.6-7.0	Clay loam	Hardpan	24-36	Well	Moderate	2.0	Medium	Good	Cropland and forest	Erosion on steeper slopes	3800-4400	17-22	90-100	43
Nagle 2/	Typic Argiustoll	Fine loamy, mixed, mesic	Gravelly silt loam	6.6-7.0	Very gravelly clay loam	Gravel	24-32	Well	Moderate	1.8	Medium	...	Range	Erosion on steeper slopes	3400-4500	13-16	100-130	45
Salisbury	Typic Durustoll	Fine, montmorillinitic, mesic	Silt loam	6.8-7.2	Clay	Hardpan	24-32	Well	Slow	2.0	Medium	Fair	Range	Erosion	3400-4500	13-16	100-130	45
Virtue	Mollic Durargid	Fine silty, mixed, mesic	Silt loam	6.4-7.8	Silty clay loam	Hardpan	20-36	Well	Moderate	2.0	Medium	Good	Cropland and range	Erosion on steeper slopes	2700-4000	9-13	100-130	46
Soils of uplands:																		
Formed from acid igneous materials:																		
Brownlee	Typic Argixeroll	Fine loamy, mixed, mesic	Silt loam	6.8-7.2	Clay loam	Bedrock	18-26	Well	Moderate	2.0	Medium	Fair	Range	Erosion on steeper slopes	2600-3600	12-14	100-120	47
Kilmerque	Andic Cumulic Haploxeroll	Coarse loamy, mixed	Loam	6.6-7.0	Loam	Bedrock	24-36	Well	Moderate	2.0	Medium	Fair	Cropland and forest	Erosion on steeper slopes	3400-4500	17-24	90-100	46
North Powder	3/	3/	Loam to stony loam	6.6-7.0	Loam to stony loam	Bedrock	30-40	Well	Moderate	1.8	Medium	Good	Cropland and range	Erosion on steeper slopes	3000-3600	10-13	90-110	46
Formed from basic igneous materials:																		
Bakeoven	Lithic Haplustoll	Loamy skeletal, mixed, mesic	Very stony loam	6.6-7.0	Very stony clay loam	Bedrock	5-12	Well	Moderately slow	0.5	Medium	...	Range	Shallowness and stoniness	3000-5000	8-24	60-90	45
Glasgow	Mollic Haplargid	Fine, montmorillinitic, mesic	Silt loam	6.3-6.8	Clay	Tuff	16-40	Well	Moderate	2.5	Medium	Fair	Range	Erosion on steeper slopes	3000-4200	10-13	90-130	47
Hall Ranch 2/	Haploxeric Cryoboroll	Fine loamy, mixed	Silt loam	6.0-6.8	Silt loam	Bedrock	24-40	Well	Moderate	2.0	Medium	...	Forest	Erosion on steeper slopes	3500-4200	18-24	90-100	45
Klicker	Argixeric Cumulic Cryoboroll	Loamy skeletal, mixed	Stony silt loam	6.2-6.6	Silty clay loam	Bedrock	16-36	Well	Moderate	2.0	Medium	...	Forest	Erosion on steeper slopes	3500-5000	18-24	90-100	45
Lookout	Mollic Durargid	Fine, montmorillinitic, mesic	Silt loam to stony or cobbly silt loam	6.4-6.8	Cobbly silty clay loam	Bedrock	20-30	Well	Moderately slow	2.2	Medium	...	Range	Erosion on steeper slopes	2800-3600	8-12	100-130	47
Mehlhorn	Typic Argixeroll	Fine loamy, mixed, mesic	Silt loam	6.4-7.0	Silty clay loam to clay loam	Bedrock	12-60	Well	Moderate	2.0	Medium	Good	Forest and range	Erosion on steeper slopes	2700-3600	18-24	100-120	48
Rock Creek 2/	Lithic Argixeroll	Loamy skeletal, mixed, mesic	Very stony loam	6.2-6.8	Very stony silty clay loam	Bedrock	5-11	Well	Moderately slow	1.8	Medium	...	Range	Shallowness and stoniness	3000-5000	17-26	60-90	43
Ruckles	Aridic Lithic Argiustoll	Clayey skeletal, mont., mesic	Very stony loam or silt loam	6.8-7.2	Very stony clay	Bedrock	10-20	Well	Moderately slow	2.2	Medium	...	Range	Shallowness and stoniness	2400-4000	10-13	100-120	47
Tolo	Eutric Thapto Boralfic Cryandept	Ashy over fine silty, mixed	Silt loam	6.6	Silt loam	Volcanic ash	30-50	Well	Moderate	2.0	Rapid	...	Cropland and forest	Erosion on steeper slopes	3500-5500	18-30	80-90	44
Formed from metamorphic rock:																		
Durkee	Typic Argiustoll	Fine, montmorillinitic, mesic	Clay loam	6.8-7.2	Clay	Bedrock	14-24	Well	Moderate	2.0	Medium	...	Range	Erosion on steeper slopes	3400-4400	12-15	90-110	45
Keating	Typic Argiustoll	Fine, montmorillinitic, mesic	Stony silt loam	6.6-7.0	Clay loam to clay	Bedrock	8-30	Well	Moderate	2.0	Medium	Fair	Range	Erosion on steeper slopes	3000-3600	13-16	90-120	46
Rouen	3/	3/	Silt loam to stony silt loam	6.0-6.6	Stony clay loam	Bedrock	20-40	Well	Moderate	2.0	Medium	...	Forest	Erosion on steeper slopes	3500-4500	18-24	90-100	45

1/ USDA, Forest Service and Soil Conservation Service.
2/ Tentative series, not yet correlated.
3/ Information not available to make classification.

Table 2.--Estimated acreage of land by capability and subclass, Powder Drainage Basin, Oregon, 1965 1/

Capability class	14-3 Oxbow	14-4 Pine Valley	14-5 Home	14-6 Benson Creek	14u-1 Eagle Valley	14u-2 Big Creek	14u-3 Lower Powder	14u-4 Wolf Creek	14u-5 North Powder	14u-6 Sumpter Valley	14u-7 Baker	14t-1 Durkee Valley	14t-2 Lower Burnt	14t-3 Middle Burnt	14t-4 Whitney	14t-5 Unity	Total basin
	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres
IIe	0	3,800	600	1,000	3,500	3,000	3,500	1,200	8,000	0	15,000	3,000	1,700	2,000	1,500	2,000	49,800
IIw	0	1,000	0	0	600	400	800	3,000	300	0	7,500	400	0	2,000	100	1,800	17,900
IIs	100	200	0	0	1,000	400	100	1,800	2,000	0	2,000	100	100	0	0	100	7,900
IIc	0	0	0	0	0	0	0	0	0	0	300	0	0	200	0	100	600
Total II	100	5,000	600	1,000	5,100	3,800	4,400	6,000	10,300	0	24,800	3,500	1,800	4,200	1,600	4,000	76,200
IIIe	0	7,000	1,400	1,500	3,500	3,900	7,300	4,000	8,500	1,500	21,700	4,000	3,000	3,000	2,500	3,000	75,800
IIIw	0	1,500	0	0	0	0	0	3,600	7,300	1,800	0	500	0	0	500	0	15,200
IIIs	0	0	0	0	0	400	200	600	0	0	0	0	0	0	0	0	1,200
Total III	0	8,500	1,400	1,500	3,500	4,300	7,500	8,200	15,800	3,300	21,700	4,500	3,000	3,000	3,000	3,000	92,200
IVe	0	5,700	1,400	3,500	2,100	6,000	5,000	5,000	4,000	5,400	22,800	1,300	1,100	800	4,500	4,600	73,200
IVw	0	0	0	0	300	0	0	0	0	0	0	200	0	0	0	0	500
IVs	0	0	0	0	600	900	1,200	700	7,800	0	14,400	600	0	400	0	0	26,600
Total IV	0	5,700	1,400	3,500	3,000	6,900	6,200	5,700	11,800	5,400	37,200	2,100	1,100	1,200	4,500	4,600	100,300
Total II-IV	100	19,200	3,400	6,000	11,600	15,000	18,100	19,900	37,900	8,700	83,700	10,100	5,900	8,400	9,100	11,600	268,700
VIe	25,600	50,600	11,200	6,600	47,000	54,800	88,100	37,000	12,000	40,000	52,300	71,000	81,000	63,000	41,000	86,400	767,600
VIs	0	0	0	0	0	0	900	3,300	500	0	4,000	0	0	0	0	0	8,700
Total VI	25,600	50,600	11,200	6,600	47,000	54,800	89,000	40,300	12,500	40,000	56,300	71,000	81,000	63,000	41,000	86,400	776,300
VIIe	46,100	40,600	56,900	3,300	109,800	63,700	32,000	36,800	57,000	37,300	57,000	82,400	28,000	44,100	43,500	70,100	808,600
VIIs	24,000	10,000	4,000	0	21,000	15,000	4,000	7,000	3,000	7,000	6,000	3,500	3,000	6,000	5,000	6,000	124,500
Total VII	70,100	50,600	60,900	3,300	130,800	78,700	36,000	43,800	60,000	44,300	63,000	85,900	31,000	50,100	48,500	76,100	933,100
VIII	5,400	7,800	1,800	0	14,400	6,400	1,800	2,000	7,200	11,000	17,100	2,500	1,200	5,400	4,400	2,600	91,000
Total VI-VIII	101,100	109,000	73,900	9,900	192,200	139,900	126,800	86,100	79,700	95,300	136,400	159,400	113,200	118,500	93,900	165,100	1,800,400
Water area 2/	100	200	100	0	600	400	900	200	200	100	600	300	100	200	100	500	4,600
Total in basin	101,300	128,400	77,400	15,900	204,400	155,300	145,800	106,200	117,800	104,100	220,700	169,800	119,200	127,100	103,100	177,200	2,073,700

1/ Compiled by USDA, Soil Conservation Service, Forest Service.
2/ Water areas less than 40 acres in size and streams less than 1/8 mile in width.

Land Capability

An interpretive grouping of soils into land capability classes has been developed by the Soil Conservation Service. Soil characteristics such as depth, texture, wetness, slope, erosion hazard, overflow hazard, permeability, structure, reaction, water-holding capacity, inherent fertility, and climatic conditions as they influence safe use and management of land are considered in grouping soils into eight land capability classes. These eight classes are designated by Roman numerals as indicated on the generalized land capability map (map 5). Class I land has few hazards or limitations, whereas class VIII land is so limited that it is unfit for safe or economical use for cropland, forestry, and range. It should be used only for recreation, wildlife habitat, and water supply.

The classification can be broken into two divisions: (1) land in capability classes I through IV is suited for cultivation and other uses, and (2) land in capability classes V through VIII is best suited for range, forestry, wildlife habitat, and water supply because of limitations. Land capability classes are sometimes broken into subclasses to indicate the dominating limitation or hazard. The subclasses are "e" for wind or water erosion, "w" for wetness or frequent inundation from overflow, "s" for soil limitation, and "c" for climatic limitations.

An estimate has been made of the amounts of land in each capability class and subclass for each watershed. These data were developed from the Oregon Soil and Water Conservation Needs Inventory 1/ and soil surveys within the Powder Drainage Basin (table 2).

SOCIAL AND ECONOMIC FEATURES

Population and Economy

Data on social and economic characteristics are unavailable for the Powder Drainage Basin; however, over 95 percent of the land area of Baker County, Oregon, is included within the basin boundaries and less than 10 percent of the basin land area lies outside of Baker County. Thus, most of the data in this section pertain to Baker County.

The population of Baker County in 1965 was 15,600 (table 3) or about 0.8 percent of the state's population. The rural nature of the area is reflected by the population density of 5.1 persons per square mile as compared to 20.5 for the State of Oregon.

The largest city in the basin is Baker with a population of 9,200 in 1965. Huntington is the second largest city with a population of 634 and all other towns have fewer than 500 inhabitants. About 59 percent of the people

1/ The Oregon Conservation Needs Committee, Portland, Oregon, September 1962.

live in Baker, 11 percent live in other small incorporated towns, and 30 percent live in rural communities or on farms.

Table 3.--Population trends, Baker County, Oregon, 1870-1965 1/

Year	Number of inhabitants		
	Baker County	City of Baker	Rural farm
	Number	Number	Number
1965	15,600	9,200	...
1964	15,148	9,279	...
1960	17,295	9,924	3,027
1950	16,175	9,471	3,972
1940	18,297	9,342	5,036
1930	16,754	7,858	5,544
1920	17,929	7,729	...
1910	18,076	6,742	...
1900	15,597	6,663	...
1890	6,764	2,604	...
1880	4,616	1,258	...
1870	2,804	312	...

1/ U. S. Bureau of the Census, U. S. Census of Population, 1870-1960 and Population Bulletin, Oregon State Board of Census.

The most important basic industry in Baker County is agriculture. Manufacturing of lumber and wood products associated with forestry and manufacturing of durable goods associated primarily with the mining and processing of lime constitute the other basic industries of major importance. All of these industries are oriented to the natural resources of the basin and form the economic base for the other secondary activities.

One measure of the importance of the various sectors of the economy is employment. Total employment in Baker County in 1960 was 6,381 (table 4).

Agriculture and the manufacturing of food and kindred products, which is directly related to agriculture, was the source of employment for 1,386 people or about 21.7 percent of the labor force. Forestry and the manufacturing of lumber and wood products accounted for employment of 548 people or 8.6 percent of the labor force.

Mining and the manufacturing of durable goods provided employment for another 191 people or 3 percent of the labor force. Most important within this category is the lime mining and processing industry which, in 1964, employed about 138 people 2/.

2/ 1964 Directory of Oregon Manufacturers and Buyer's Guide, State of Oregon Department of Planning and Development, p. 47.

LEGEND

LAND SUITED FOR CULTIVATION AND OTHER USES

CLASS II — Soils in Class II have few limitations or hazards. Simple conservation practices are needed when cultivated. They are suited to cultivated crops, pasture, range, woodland, or wildlife.

CLASS III — Soils in Class III have more limitations and hazards than those in Class II. They require more difficult or complex conservation practices when cultivated. They are suited to cultivated crops, pasture, range, woodland, or wildlife.

CLASS IV — Soils in Class IV have greater limitations and hazards than Class III. Still more difficult or complex measures are needed when cultivated. They are suited to cultivated crops, pasture, range, woodland, or wildlife.

LAND LIMITED IN USE — GENERALLY NOT SUITED FOR CULTIVATION

CLASS VI — Soils in Class VI have severe limitations or hazards that make them generally unsuited for cultivation. They are suited largely to pasture, range, woodland, or wildlife.

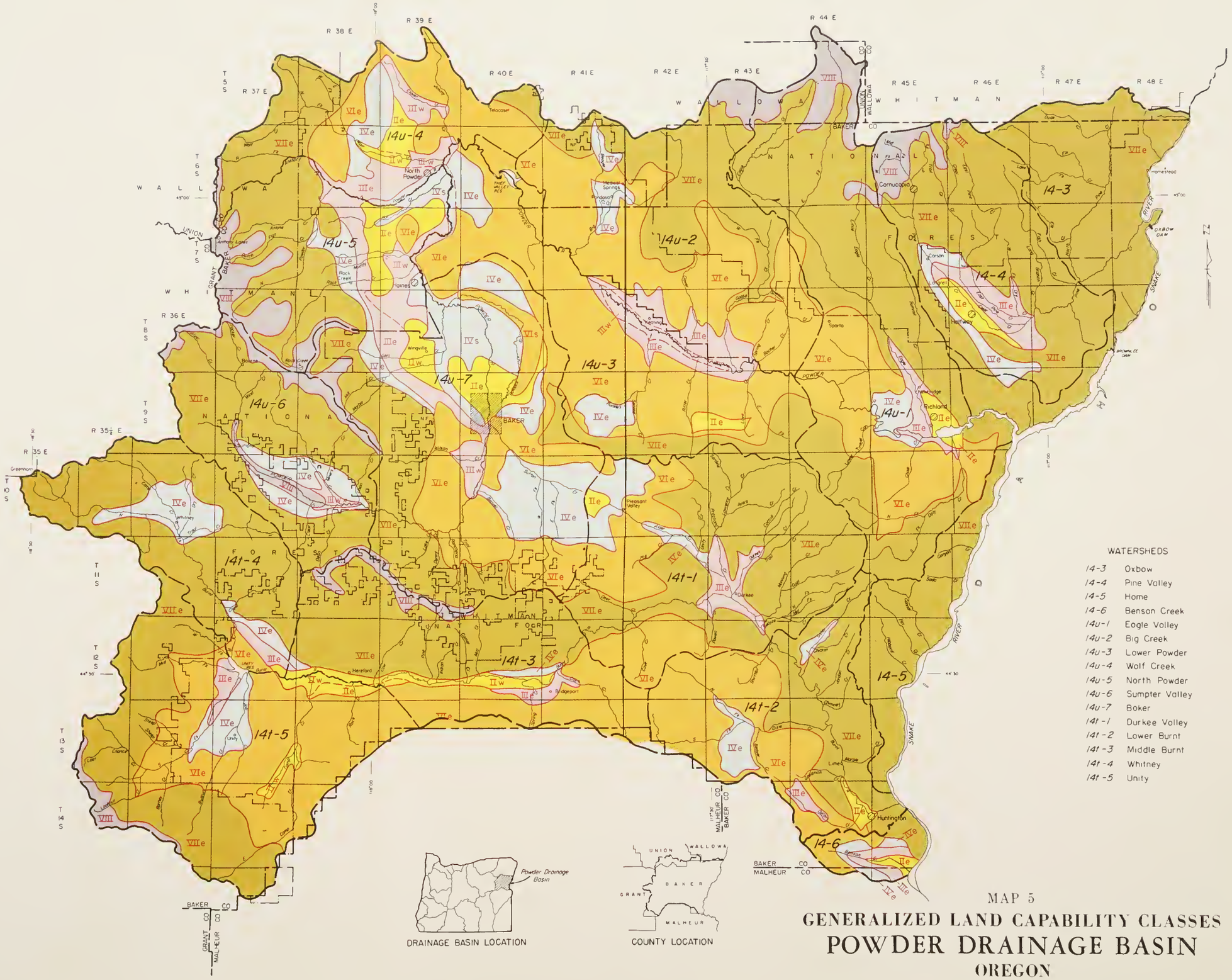
CLASS VII — Soils in Class VII have very severe limitations or hazards that make them generally unsuited for cultivation. They are suited to grazing, woodland, or wildlife.

CLASS VIII — Soils and land forms in Class VIII have limitations and hazards that prevent their use for cultivated crops, pasture, range, or woodland. They may be used for recreation, wildlife or water supply.

SUBCLASSES

- e Erosion
- s Soil
- w Wet or Overflow

Drainage Basin Boundary
Watershed Boundary
National Forest Boundary



WATERSHEDS

14-3	Oxbow
14-4	Pine Valley
14-5	Home
14-6	Benson Creek
14u-1	Eagle Valley
14u-2	Big Creek
14u-3	Lower Powder
14u-4	Wolf Creek
14u-5	North Powder
14u-6	Sumpter Valley
14u-7	Baker
141-1	Durkee Valley
141-2	Lower Burnt
141-3	Middle Burnt
141-4	Whitney
141-5	Unity

DRAINAGE BASIN LOCATION

COUNTY LOCATION

MAP 5

GENERALIZED LAND CAPABILITY CLASSES
POWDER DRAINAGE BASIN
OREGON

JANUARY 1966

2 0 2 4 6 8
SCALE IN MILES

U S DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, USDA SCS PORTLAND OREG 1965 M-4446

7 - E - 17866 - N

Table 4.--Occupation of employed, Baker County, Oregon, 1960 1/

Industry group	Employment	Percentage distribution
	Number	Percent
Basic activities:		
Agriculture	1,295	20.3
Forestry	144	2.3
Mining	16	.3
Manufacturing:		
Lumber and wood products	(404)	(6.3)
Food and kindred products	(91)	(1.4)
Other durable goods	(175)	(2.7)
All other manufacturing	(121)	(1.9)
Total manufacturing	791	12.3
Total basic activities	2,246	35.2
Secondary activities:		
Construction	841	13.2
Transportation and communications	329	5.1
Wholesale trade	182	2.8
Retail trade	993	15.6
Services:		
Educational services	(247)	(3.9)
Public administration	(273)	(4.3)
Other services	(1,145)	(17.9)
Total services	1,665	26.1
Total secondary activities	4,010	62.8
Industry not reporting	125	2.0
Total employment	6,381	100.0

1/ Op. cit., U. S. Census of Population, General Social and Economic Characteristics, PC(1)39c, Oregon, p. 39-148.

The secondary industries--including construction, transportation, communications, trades and services--are considered to be indirectly associated with the basic industries enumerated in table 4. Some are also related to an industry of growing importance in the basin--recreation. About 63 percent of the workers in Baker County were employed in secondary industries in 1960, 35 percent were employed in the basic industries, and 2 percent were employed in the category "Industry not reporting."

Historical Economic Growth

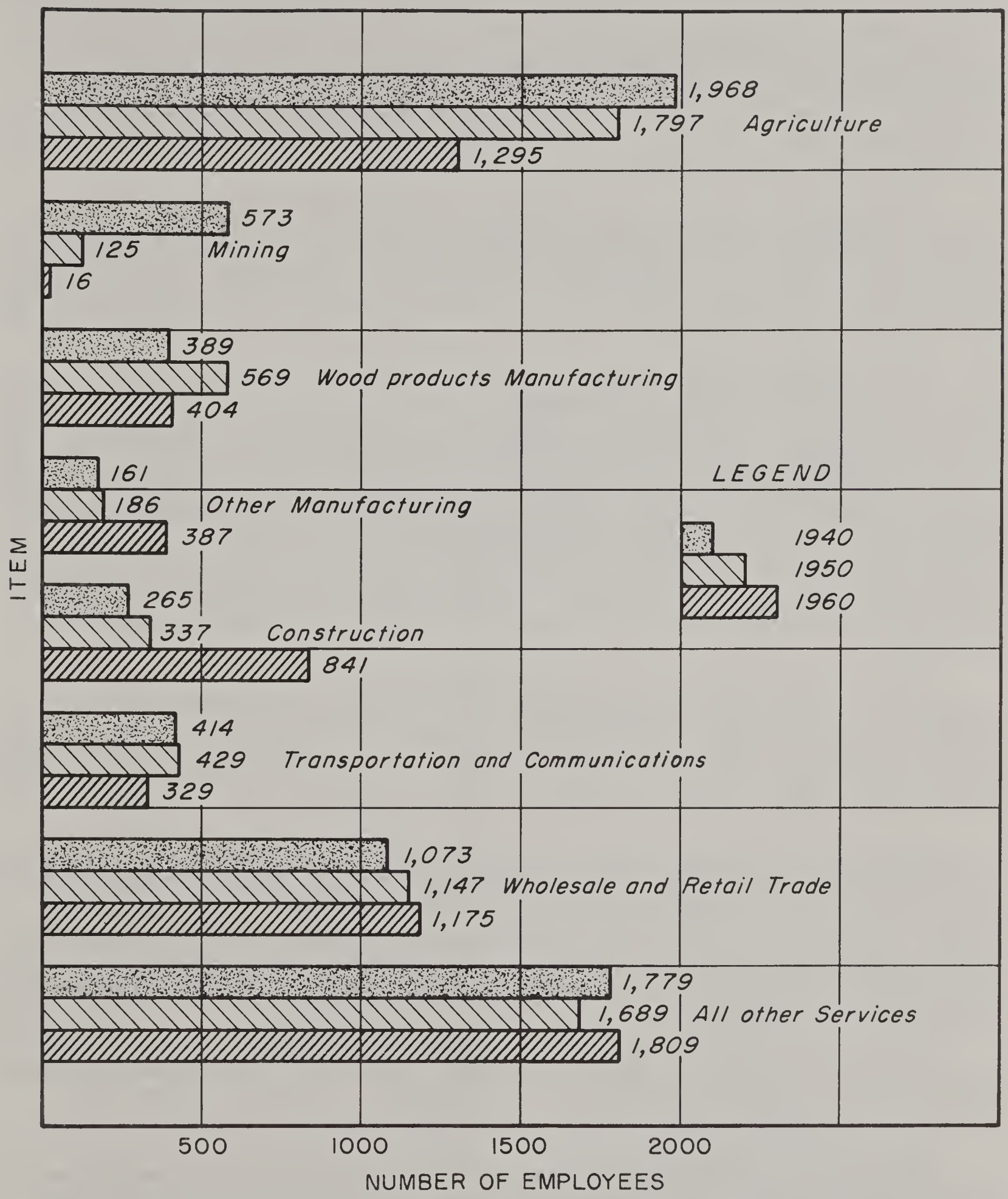
Even though the first white men passed through the Powder Valley in December 1811 and the Oregon Trail later traversed it, gold fever was the

incentive that brought the first residents. After a futile search for the fabled Blue Bucket mine, Henry Griffin arrived in the valley in the fall of 1861 and found gold in the gulch which bears his name. Griffin and three others spent the winter on their claims. When the news of their discovery reached Portland the following spring, miners began arriving in a steady stream. In June 1862, the town of Auburn was laid out with a street running from Freeze Out Gulch to Blue Canyon. It was estimated that between 5,000 and 6,000 people were in Auburn during the winter of 1862-63. Following the gold boom of 1862, the population subsided at first and then continued to grow. The population doubled between 1870 and 1880 and more than doubled between 1890 and 1900 (table 3) as the completion of the railroad in 1885 gave further impetus to growth in the basin.

The first mining was accomplished by hydraulics and ground sluice boxes. In the early 1900's, dredging operations began on the Lower Burnt River and in Sumpter Valley (photo 1). Large bucket-line dredges worked up and down the valleys leaving huge tailings of gravel. Gold mining continued sporadically until 1954 when the last dredge was shut down. The decline of gold mining in the basin is partially illustrated by figure 1. The decline of employment in mining from 573 in 1940 to 16 in 1960 is considered largely to be the result of decreased gold mining. It is estimated that since 1861 when gold was first discovered, about $150 million in gold has been mined in Baker County.

Photo 1.--This huge gold dredge operated in the Sumpter Valley. SCS.

Employment by industry group, Baker County, Oregon, 1940-50-60 1/



1/ U. S. Census of population, General Social and Economic Characteristics, years 1940, 1950 and 1960

Figure 1

Agricultural endeavors beginning shortly after the arrival of the miners were at first limited to livestock production but soon potatoes, vegetables, grain, and hardy fruits were grown to meet the demand for farm produce in mining camps. After the arrival of railroads and roads, agricultural products from other areas became more readily available and farmers turned to the production of grass, hay, and small grains. Many of the diversion ditches originally constructed for hydraulic gold mining were converted to irrigation canals. Land was brought under irrigation and livestock became the major agricultural product.

Although agricultural production has continued to increase in recent years, employment has decreased. Farms and ranches are getting larger and more mechanized and fewer workers are required. Employment in agriculture decreased by 673 workers from 1940 to 1960 (figure 1), while farm population decreased by 2,009 (table 3).

The logging industry began with the cutting of timber for mines and for cabin logs. Soon a sawmill was built to provide lumber for the growing towns. The first shipment of lumber from Baker was in 1887 when 13 carloads of lumber were shipped to Ogden, Utah. Timber harvest in Baker County has fluctuated widely from year to year but has been generally increasing since 1950 (figure 4, page 33). Also, logs have been imported into Baker County from outside the basin. Although timber harvest has increased by five times the 1950 level, employment in the timber industry in Baker County has decreased by 165 workers from 1950 to 1960. Consolidation into larger, more economical units and changes in technology have brought about this decrease in employment.

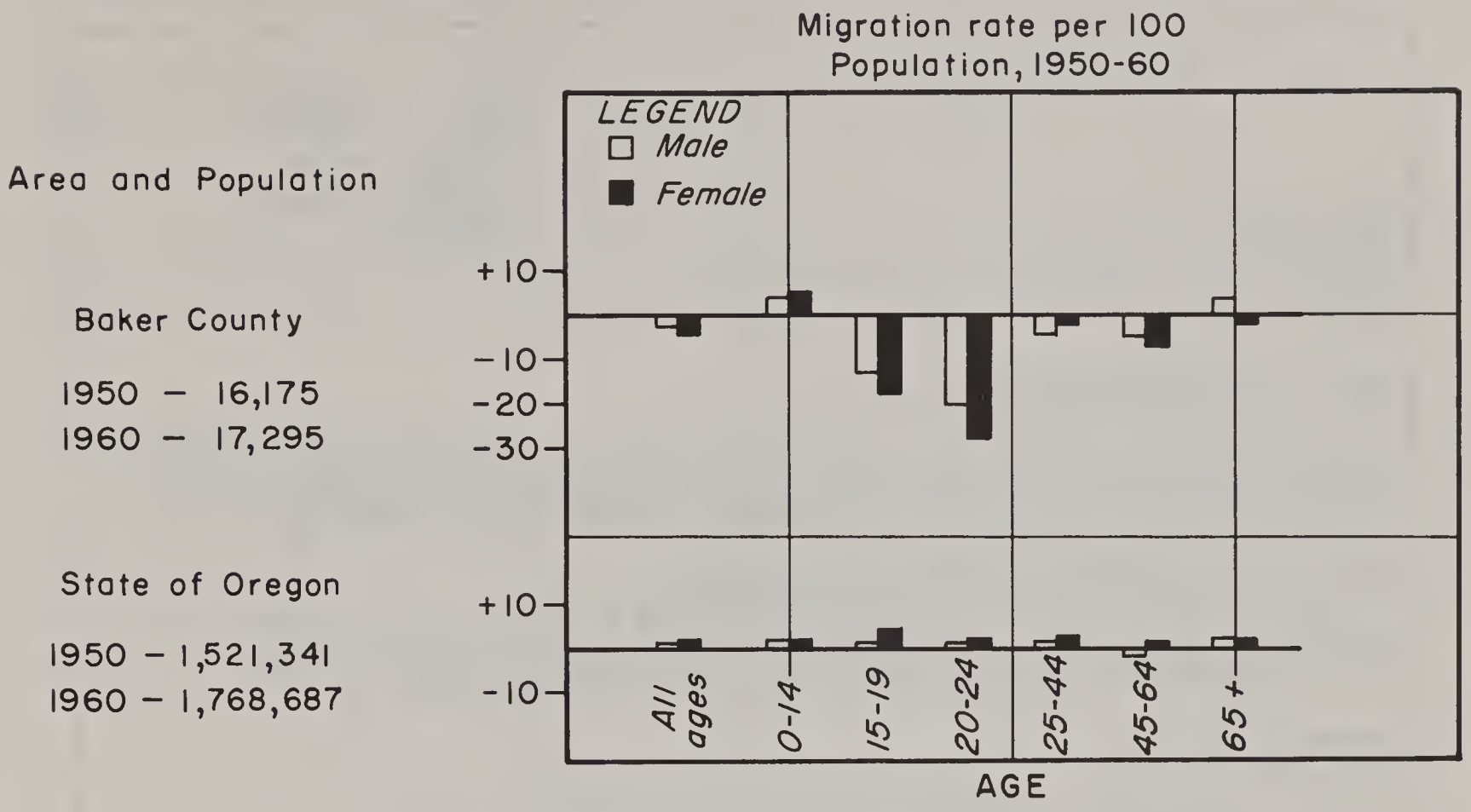
The loss in employment in mining, agriculture, transportation, and cummunication has been offset by gains in employment in construction, wholesale and retail trades, and services (figure 1). Consequently, total employment changed very little from 1940 to 1960. Total employment in Baker County was 6,680 in 1940, 6,385 in 1950, and 6,381 in 1960.

Although employment in the transportation and communications industries has decreased since 1940, other secondary industries such as retail sales and services have gained because of the transportation facilities in the basin. Service and retail establishments such as gas stations, motels, and restaurants have especially benefited from traffic on U. S. Highway 30. Recreational use of the basin's resources has also been enhanced because of the major U. S. highway.

The construction of dams on the Snake River has been a major factor in increasing the number of workers in construction. Employment more than doubled in construction work from 1950 to 1960.

The lack of sufficient job opportunities in the basin has led to out-migration of people. The natural increase in population from births has about kept pace with the out-migration and population has remained fairly stable since 1910. From 1950 to 1960, the out-migration rate was about 3 percent for Baker County as compared to an in-migration rate of 2 percent for the State of Oregon. The largest group of migrants was from 15 to 24 years of age, indicating that young people entering the labor market were

Population migration rates by age groups,
Baker County and Oregon, 1950-60 1/



Area and Population

Baker County

1950 – 16,175
1960 – 17,295

State of Oregon

1950 – 1,521,341
1960 – 1,768,687

1/ *Population Bulletin P-8, Oregon State Board of Census, June 1963.*

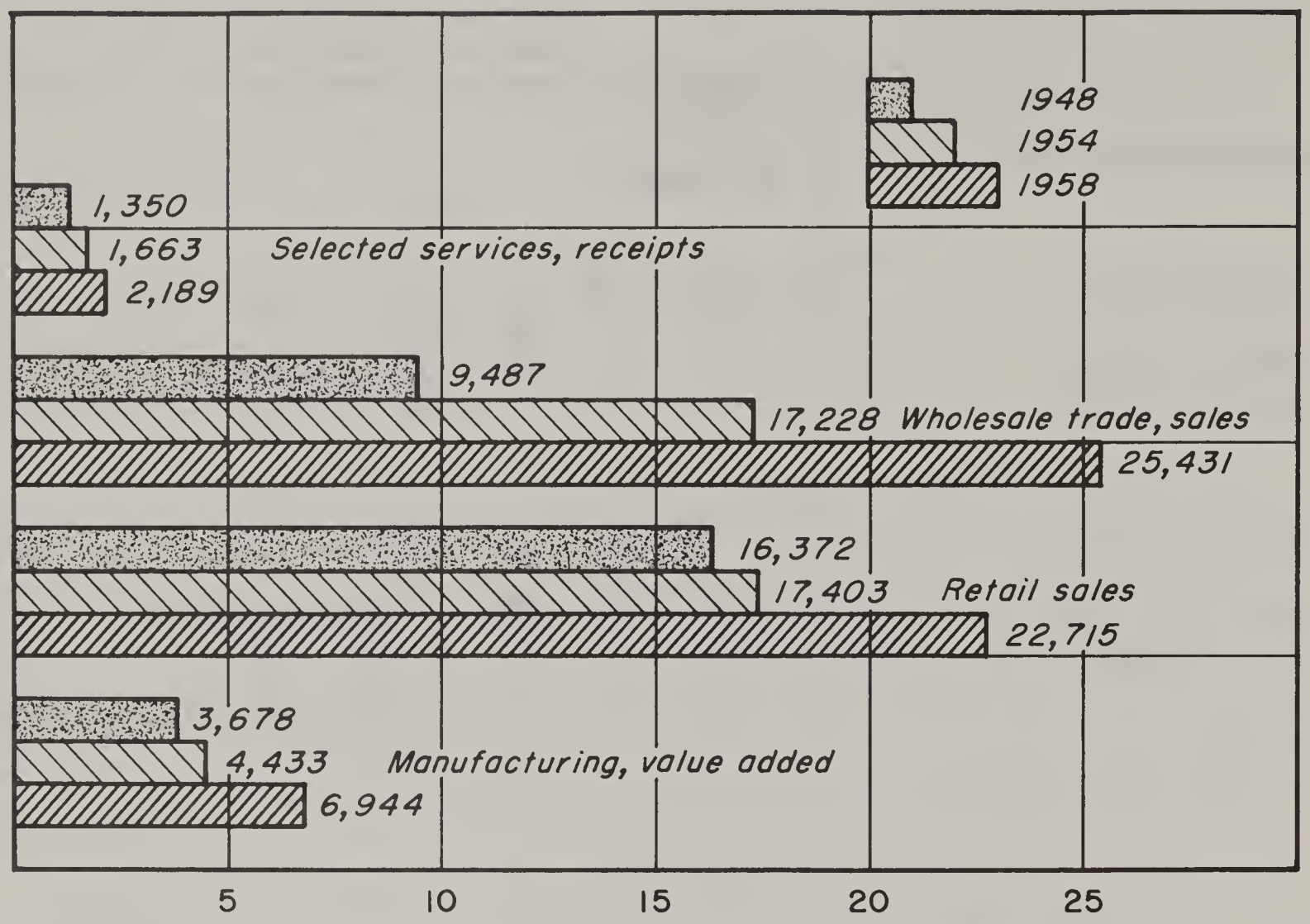
Figure 2

most affected by the lack of job opportunities. The drop in population since 1960 indicates that out-migration is continuing at a higher rate.

When job opportunities are restricted, as they have been in Baker County, out-migration can provide a relief valve needed to permit levels of living to increase. Median family incomes increased from $2,808 in 1950 to $5,266 in 1960 or 88 percent. Comparable figures for the State of Oregon were $3,476 and $5,892 or an increase of 70 percent. If out-migration had not occurred, levels of living in Baker County may have been lower in 1960.

Another measure of economic activity is dollar value of receipts and sales. Figure 3 illustrates the changes in receipts from services, retail and wholesale sales, and value added by manufacturing. Dollar values have increased in all groups since 1948. Major gains in retail and wholesale sales were made from 1954 to 1958. The real increase in business activity would be somewhat less than that indicated because inflation occurred during this period. The increase in volume of business and the out-migration of people probably helped account for the rise in the level of living which was higher in Baker County than for the State of Oregon.

Volume of business in dollars, Baker County, Oregon, 1948-54-58 1/



1/ *U..S..Census of Manufactures, Census of Retail Trade, Wholesale Trade, and Selected Services.*

Figure 3

Transportation

Baker, the transportation center of the basin, is located on the main highways, on the rail line, and near the commercial air-line facilities. Other towns have local service from Baker or are on main highways with interstate bus and motor freight service.

Interstate Highway 80N or U. S. Highway 30 bissects the basin diagonally from the northwest to the southwest, connecting the cities of North Powder, Haines, Baker, Huntington, and points outside the basin. U. S. Highway 26 cuts across the basin at Unity in the southwest corner. State Highways 7 and 220 run south and west from Baker connecting Baker with Sumpter, Hereford, and Unity. State Highways 203 and 237 extend north from Baker connecting it with Union and La Grande which are outside the basin. State Highway 86 running

east from Baker leads to Richland, Halfway, Copperfield, Homestead, Oxbow, and Idaho Power Company's dams and hydroelectric plants. Secondary roads provide access to the small villages, farms, and grazing and forest areas.

The main line of the Union Pacific Railroad which parallels U. S. Highway 30 across the basin provides transcontinental passenger and freight service to Baker, Huntington, Haines, and North Powder.

The Oregon State Board of Aeronautics lists four airports located in the basin. The Baker Municipal Airport has commercial air-line facilities and is served by West Coast Air Lines. Privately owned and operated airports at Haines and at Homestead accommodate smaller planes.

Landownership and Land Use

The use of land in the basin is influenced by the ownership. Half of the land is federally owned, 2 percent is owned by state, county, and municipal governments, and 48 percent is privately owned. The landownership status is presented in map 6 and the generalized land use is presented in map 7. A tabulation of ownership and use is presented in table 5.

Table 5.--Landownership and land use status,
Powder Drainage Basin, Oregon, 1965 1/

Ownership	Range	Crop and pasture	Forest	Other	Total
	Acres	Acres	Acres	Acres	Acres
Federal:					
National Forest	55,500	...	550,000	61,900	667,400
Public Domain 2/	333,600	...	36,900	2,000	372,500
State	9,500	...	1,000	10,000	20,500
County & Municipal	...	...	1,000	12,200	13,200
Private	607,600	196,000	172,800	23,700	1,000,100
Total	1,006,200	196,000	761,700	109,800	2,073,700

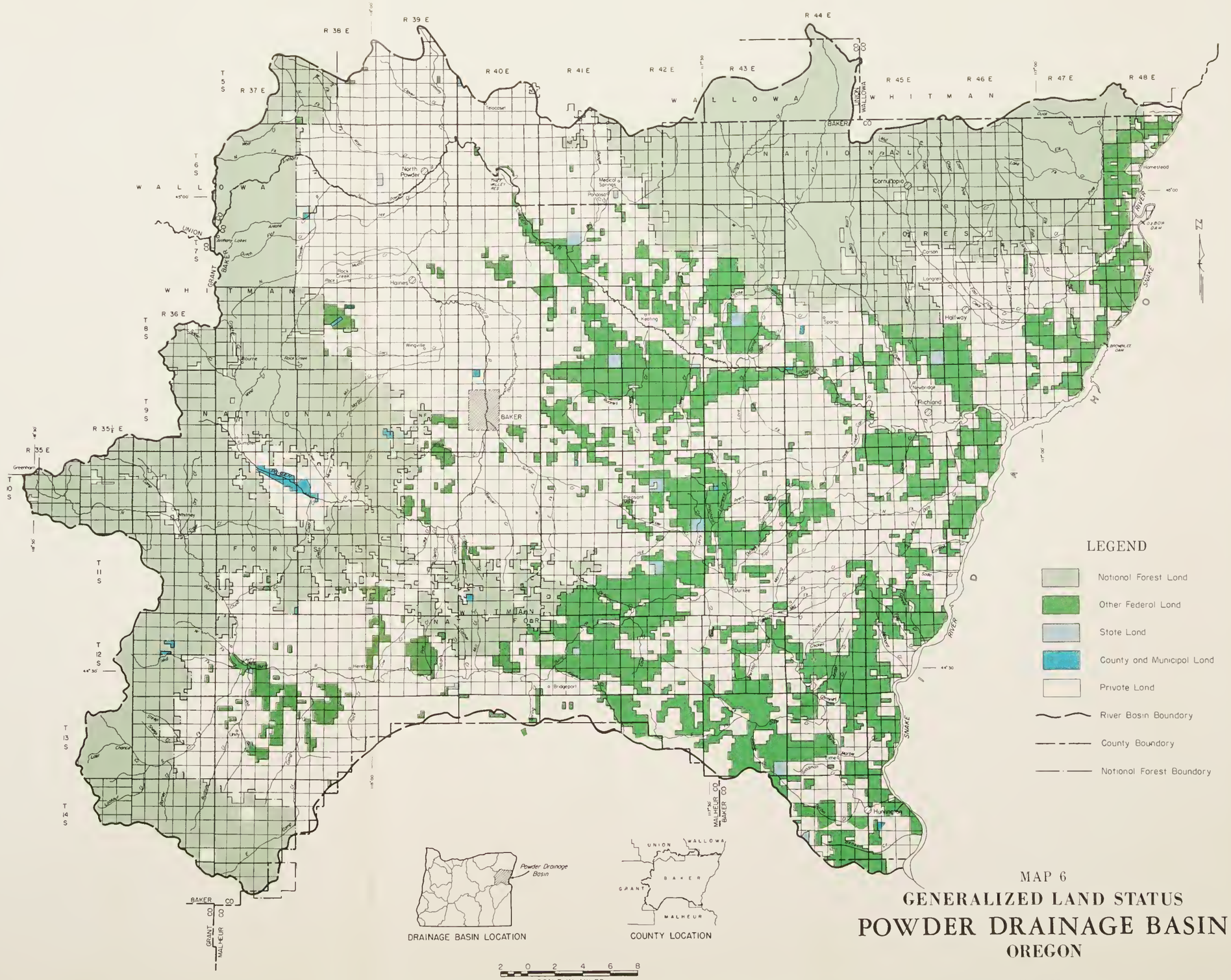
1/ USFS, BLM, and Oregon Tax Commission data adjusted to basin.
2/ Includes other federal ownerships.

About 37 percent of the basin, mainly in the western and northern parts of the basin at higher elevations, is forested land. About three-fourths of the forest land is in the Wallowa-Whitman National Forest which is managed by the Forest Service.

Almost half of the basin is rangeland with the central, southern, and eastern parts being predominantly rangeland. About 60 percent of the range-

land is privately owned, and 33 percent is in public domain which is managed by the Bureau of Land Management. The public domain land is scattered and intermingled with privately owned rangeland throughout the basin.

Less than 10 percent of the basin area is cropland in private ownership. The largest block of cropland lies in the Powder River Valley north of Baker. Other cropland areas lie in river valleys throughout the basin or at higher elevations where rainfall is sufficient for dryland crops.



MAP 6

GENERALIZED LAND STATUS
POWDER DRAINAGE BASIN
OREGON

JANUARY 1966

7-E-17866-N

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, USDA SCS PORTLAND, OREG. 1966 M-4415

LEGEND

- Forest
- Upper Slope Forest and Alpine Zone
- Mixed (Forest – Range)
- Range
- Cropland
- Mixed Cropland

- Drainage Basin Boundary
- Watershed Boundary
- National Forest Boundary

WATERSHEDS

14-3	Oxbow
14-4	Pine Valley
14-5	Home
14-6	Benson Creek
14u-1	Eagle Valley
14u-2	Big Creek
14u-3	Lower Powder
14u-4	Wolf Creek
14u-5	North Powder
14u-6	Sumpter Valley
14u-7	Baker
14t-1	Durkee Valley
14t-2	Lower Burnt
14t-3	Middle Burnt
14t-4	Whitney
14t-5	Unity

DRAINAGE BASIN LOCATION

COUNTY LOCATION

MAP 7

GENERALIZED LAND USE

POWDER DRAINAGE BASIN

OREGON

JANUARY 1966

SCALE IN MILES

U S DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE USDA SCS PORTLAND OREG 1965 M-4446

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FOREST LAND MANAGEMENT IN THE BASIN

INTRODUCTION

Forest land in the Powder Drainage Basin occupies 37 percent of the total area or 761,700 acres (table 6). The forests are almost exclusively softwoods with small stringers of hardwoods in the valleys. The forest zone begins about 4,000 feet above sea level. Tree growth is limited by moisture at lower elevations. Usually a belt of western juniper occurs between the forest and grassland.

Ponderosa pine predominates on much of the forested area and often occurs in pure stands at lower elevations. As elevation increases and moisture conditions become more favorable, such species as Douglas-fir, white fir, western larch, lodgepole pine, and western white pine are found in increasing proportions. On the cool, moist, upper slopes, generally above 6,000 feet elevation, alpine fir, lodgepole pine, and Englemann spruce predominate. Extensive pure stands of lodgepole pine are often found at higher elevations in areas where fire, insects, or disease killed the original stand.

Areas of grassland, occasionally exceeding 1,000 acres, are intermingled in the forest-land zone. These areas occur in all elevation zones and furnish much of the summer feed for livestock and big game.

Forests are an ever-changing association of plants and animals which are affected by man's actions. They are the source and storage area for much of the basin's water. They are the source of the raw material for a large segment of the basin's industry. They are the home of a large variety of game animals and the summer range for livestock. They are the center for the rapidly expanding field of outdoor recreation. Each of these key values will be discussed in the following sections of the report. Other fields of forest-land management will be discussed where they are directly pertinent to the forest situation.

PROTECTION OF FOREST LANDS

Part of the job of forest management is the protection of forests from fire and other damage-causing agents. Sometimes overlooked by people unfamiliar with forest management is the need for protection from insects, disease, animals, and weather. These needs are considered in planning timber harvest.

One of the guides for selecting ponderosa pine for harvest is based on the relative health of each tree as indicated by the size and density of the crown. Healthy trees with luxurious crowns are often resistant to attacks from insects and disease. The possible occurrence of wind damage is considered when selecting areas or trees for harvest.

Photo 2.--Forests are the source and storage area for much of the basin's water. SCS

In order to reestablish the forest after harvest, it is sometimes necessary to take measures to prevent or control animal damage. In some instances, the rodent population may need to be controlled to prevent excessive loss of tree seed or excessive nipping of planted tree seedlings. Occasionally, sensitive areas like recent burns, plantations, and municipal watersheds, must be protected from overuse of big game by fencing, when feasible, or through special hunts set by the Oregon State Game Commission. Studies aimed at reducing animal damage are being conducted by the Oregon State Game Commission, the Bureau of Land Management, the Forest Service, and other agencies.

Maintenance of an optimum watershed condition on forest lands in the Powder Drainage Basin depends upon protection of the land from widespread wildfire. Fires often cause the destruction of the vegetative cover and soil organic matter, which in turn produces accelerated soil erosion and rapid surface runoff resulting in downstream flooding and siltation. Adequacy of fire protection will also determine, to a large extent, the economic value realized from tree farming and livestock ranching. This is particularly true of land used for timber production because many years are required to produce a

Table 6.--Forest area and timber volumes by forest type and ownership class, Powder Drainage Basin, Oregon, 1965 1/

Type	UNRESERVED												RESERVED 2/		Total forest land	
	Private		State		County & municipal		National Forest		BLM		Total unreserved		Total reserved			
	Acres	MMBF	Acres	MMBF	Acres	MMBF	Acres	MMBF	Acres	MMBF	Acres	MMBF	Acres	MMBF	Acres	MMBF
Commercial forest:																
Mature 3/																
Ponderosa pine	54,540	347.0	230	2.0	320	3.5	255,640	3,059.0	6,010	42.8	316,740	3,454.3	2,560	18.5	319,300	3,472.8
Associated species	23,150	435.0	0	0	140	2.5	159,450	2,244.6	5,460	38.8	188,200	2,720.9	3,780	53.3	191,980	2,774.2
Lodgepole pine	1,940	19.0	0	0	70	0	19,180	82.7	180	1.2	21,370	102.9	1,350	7.4	22,720	110.3
Hardwoods	1,370	0	0	0	70	0	330	20.2	0	0	1,770	20.2	0	0	1,770	20.2
Immature																
Ponderosa pine	50,670	13.0	130	0	150	0.5	50,460	60.2	1,640	6.2	103,050	79.9	960	3.5	104,010	83.4
Associated species	11,880	17.0	0	0	150	0.5	8,080	8.4	910	3.4	21,020	29.3	550	1.5	21,570	30.8
Lodgepole pine	300	1.0	0	0	0	0	12,030	0	90	0	12,420	1.0	0	0	12,420	1.0
Hardwoods	1,070	0	0	0	0	0	0	0	200	0	1,270	0	30	0	1,300	0
Nonstocked	1,740	0	0	0	0	0	330	0	50	0	2,120	0	190	0	2,310	0
Subtotal	146,660	832.0	360	2.0	900	7.0	505,500	5,475.1	14,540	92.4	667,960	6,408.5	9,420	84.2	677,380	6,492.7
Noncommercial	26,140	0	640	0	100	0	26,440	0	12,000	0	65,320	0	19,000	0	84,320	0
Total	172,800	832.0	1,000	2.0	1,000	7.0	531,940	5,475.1	26,540	92.4	733,280	6,408.5	28,420	84.2	761,700	6,492.7

1/ USFS, BLM, and Oregon Tax Commission data adjusted to basin.
2/ Eagle Cap Wilderness and Bureau of Reclamation, Fish & Wildlife Service, Department of Defense, Restricted Type of Land.
3/ 11 inch D.B.H. and larger, except 5 inch and larger for lodgepole pine.

Photo 3.--Healthy young pine is left after the mature timber has been harvested. FS

marketable crop, and fire, at any time during this period, could destroy the entire investment.

The wildfire season in the basin extends from June to October and reaches its peak in August. It is characterized by a near absence of precipitation, low daytime humidity, high temperatures, and strong winds. Although lightning is the predominate cause of fires, there is a great amount of effort necessary among the public agencies to prevent and to reduce the occurrence of man-caused fires. Statistics from the Wallowa-Whitman National Forest indicate that an average of 24 fires each year are man caused and 177 are caused by lightning on lands protected by the Forest Service. Ground fuels, consisting of light and flashy grass and litter, make prompt initial suppression action important if large fires are to be avoided.

Access via roads and trails is usually adequate in the more hazardous low elevation areas; however, most of the upper watersheds are relatively inaccessible, necessitating the use of smokejumpers.

Fire protection in the basin is shared by the Federal Government, the State of Oregon, and rural fire districts. There is a great amount of co-operation among these groups in their fire-protection efforts. The Federal

Photo 4.--The Anthony Lakes fire in 1960 burned 20,000 acres before being controlled. FS

Government, acting through the U. S. Forest Service and the Bureau of Land Management, protects federal forests, range, and some adjacent private lands. The State of Oregon protects other forested lands and intermingled and adjacent nonforested land not protected by the Federal Government. The rural fire-protection districts protect town and ranch properties in a few of the more settled areas.

TIMBER

The forest stands occur as solid blocks in the mountainous areas--mostly located in the northern and western portions of the basin. Open areas of varying size are prevalent on south slopes and on ridge tops.

Characteristics of the Resource

Approximately 668,000 acres of land in the basin are suitable for growing commercial timber. This commercial forest land presently supports a stand of 6,408 million board feet of commercial timber. 1/ Ownership of this commercial

1/ All timber volumes used in this report are in log scale Scribner rule in trees 11 inches in diameter and larger.

forest land and timber is shown in table 6. In addition, 5,000 acres, with 61 million board feet of timber, are withheld from commercial harvest. This reserved commercial timber is primarily in the Eagle Cap Wilderness part of the Wallowa-Whitman National Forest.

Some 84,300 acres of forest land are unsuitable for producing commercial timber. This land, consisting mainly of steep, rocky areas and small areas of subalpine timber just below timberline, is classified "noncommercial-unproductive" forest land. Most of it is found at the high elevations within the Wallowa-Whitman National Forest.

About three-fourths of the forest land supports stands of timber which are over 150 years old. This timber is past technical rotation age (rotation age is 125-140 years in the basin). Thrifty trees under good management practices continue growth at acceptable rates to age 200 years and beyond. Full potential growth of timber will be realized when all stands include an even distribution of age classes, younger than rotation age; however, this cannot be realized over a short period of time. The over-rotation age stands will be harvested as rapidly as feasible consistent with the principles of sustained yield and at rates that will assure a sustained supply of timber until present young-growth stands reach maturity.

History and Trends in Development and Marketing

Timber harvesting began with the early miners in the 1860's. Logs and lumber during the first 20 or 25 years were used locally in the mines or for buildings. The first shipment of lumber out of Baker County occurred in 1887 when 13 carloads of pine were shipped to Ogden, Utah. Logging was concentrated in the ponderosa pine timber stands because pine was the most desirable and accessible species. Since 1950, a significant amount of white fir, Douglas-fir, and other species has been harvested, and this trend will continue with increased markets and accessibility of these species.

Lumber has been the primary product manufactured from the basin's timber. Ponderosa pine is cut into boards or further manufactured into molding by the very large mills. Associated species are cut into dimension lumber, particularly studs.

These products have been shipped by rail primarily to the Midwest and East. Very few products are transported from the mills by trucks. Wood products from the basin's mills have been curtailed in the California markets by adverse rail freight rates.

Mills basically dependent on the basin for their supply of timber are located at Baker, Halfway, and Unity. These mills have a combined installed capacity of 80 million board feet. In addition, about 25 million board feet of logs per year will be required by a plywood plant recently installed at Baker. This plant will specialize in producing interior-grade plywood from Douglas-fir, larch, spruce, and pine. Some of the basin's timber, particularly from the north end, is milled at La Grande, Elgin, and Union.

Utilization of timber has steadily improved in recent years, but there are still many opportunities for improvement. Presently, the only market for

waste products of lumber and plywood manufacture is the general market for pulp chips. Some chips are shipped to paper mills at Lewiston and Wallula. A particle board plant is under construction in the La Grande area. Much of the waste material is burned--some is used as fuel to produce power to run the mills.

Harvesting and Regeneration Methods

Timber harvesting practices vary widely with ownership. Much of the private land which furnished the major part of stumpage in the past has been cut over and no longer has appreciable stands of merchantable timber. The private ownership of commercial forest land amounts to 146,660 acres--about 95 percent is farmer-owned and the remainder is owned by forest industry and miscellaneous owners, approximately 3 and 2 percent, respectively. State, county, and municipal timberland does not exceed 2,000 acres; consequently, industry is dependent upon national forest and public domain for a sustained supply of raw material. Both the Forest Service and the Bureau of Land Management manage the public timber on a sustained-yield basis--that is, harvesting is kept in balance with growth. More and more emphasis is being given to improving and to selecting management practices which will sustain the productivity of the land and adequately safeguard the soil and water resources.

Partial harvesting cuts have been on an individual tree or group selection basis. Overstory removal cuts are applied when adequate advance regeneration is already present. Regeneration cuts may be either patch clearcuts or final overstory removal in preparation for natural or artificial reforestation. Regeneration practices include protecting existing young trees during logging, leaving groups of trees as a source of seed, and occasionally aerial seeding. Tree planting is successful when competing vegetation is adequately controlled. Tree protection from big game and rodents may be necessary in some areas. Livestock is usually adequately controlled to protect seedlings but, at times, local damage occurs along or near heavily grazed streamsides, bedding grounds, or other concentration points.

Harvesting practices on public domain lands are similar to those on National Forest land. Mature timber is harvested from these lands on a single tree selection basis. Overmature, defective, or slowly growing trees are cut, leaving the more vigorous trees to continue growth and to provide seed for future production.

Both the Forest Service and the Bureau of Land Management are concerned with the location, design, and construction standards of skid and truck roads in an effort to limit erosion and to maintain satisfactory water flow and quality. Disturbed areas are seeded with grass or other other appropriate measures are taken to restore adequate cover.

The productivity of the Federal lands is increased through reforestation and thinning practices which aim toward attaining the best spacing of trees per acre.

Roads built for harvesting timber provide access for reforestation and thinning work, for detection and control of fires, disease, and insects, and for the use of hunters, fishermen, and other recreationists.

Most of the cutover land in the basin has been logged by tractor. In areas of steep ground with erosive soil and particularly where skid roads were located and used without sufficient attention for soil protection, considerable damage to the watershed has resulted. This applies more to past logging operations in the lower watersheds; however, there is always room for improvement. Increasing attention to soil and watershed protection is being given today in planning and in administering logging operations on public lands. Areas where vegetative cover has been removed and which are subject to erosion are water barred, seeded, planted, or otherwise treated to prevent soil loss. Even with these measures, some erosion may result because vegetative cover is slow in reestablishing and because of heavy spring runoff from the melting snow. As harvesting of mixed conifer stands extends to the steeper ground on National Forest land, some form of cable logging will be necessary.

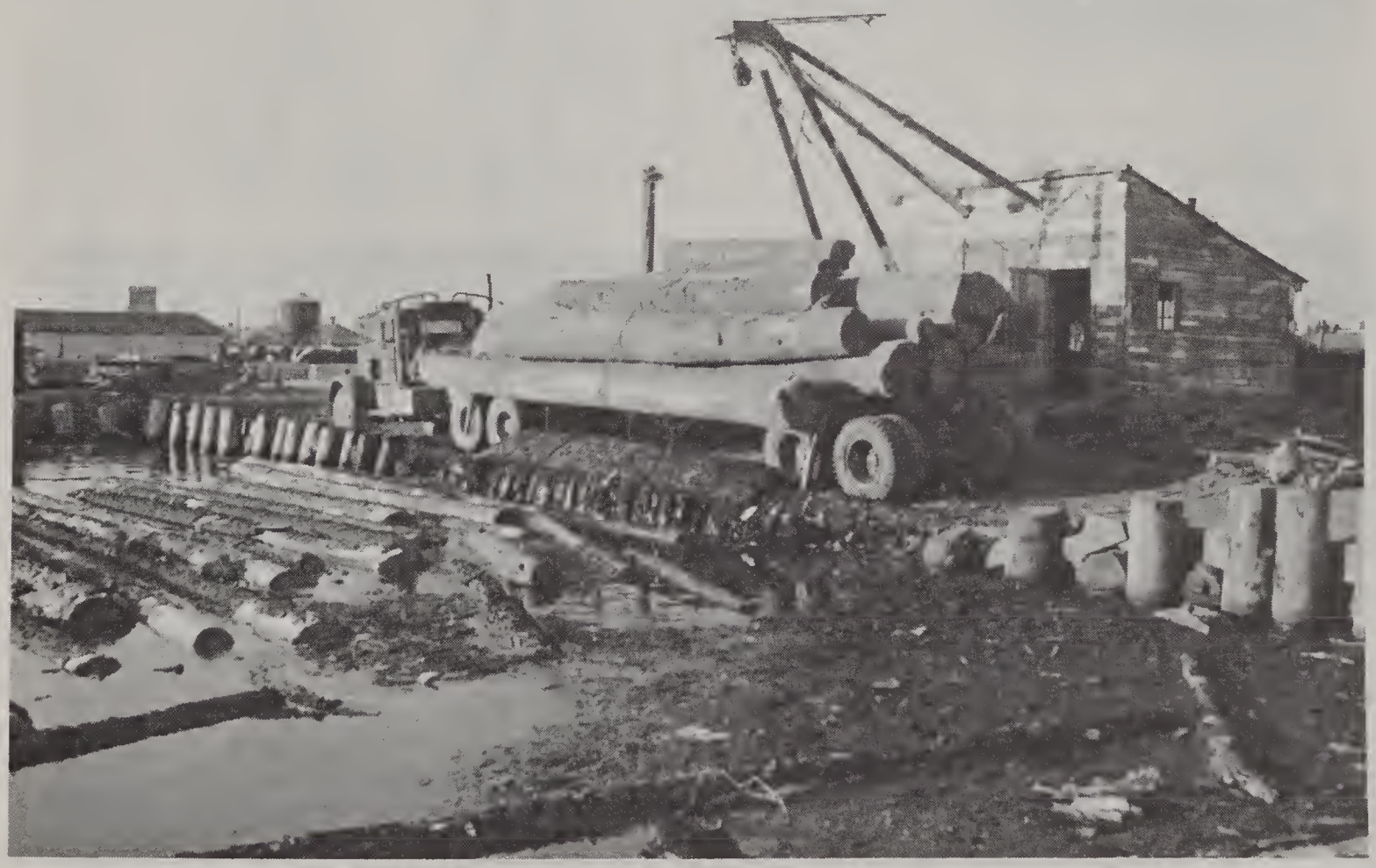


Photo 5.--The basin's sawmills depend upon trucks for their log supply. FS.

Logs are usually skidded in 16- to 40-foot lengths and are hauled by trucks to the sawmill over a network of timber access roads which connect with county, state, and federal transportation systems. The timber access roads make the forest land more readily accessible for all phases of intensive management and use but present problems in soil and water conservation.

Sustained-Yield Potential

The annual sustained-yield timber production of all commercial forest lands in the Powder Drainage Basin is expected to be between 80 million and 88 million board feet, depending upon the intensity of management that is achieved under both public and private ownership.

Public Ownership

The present allowable timber harvest from Federal forest land in the basin is approximately 65 million board feet. Sixty-three million board feet of this is National Forest production; approximately two million is from the public domain forest land. These figures were derived by prorating the annual allowable cut figure for the various working circles included in the basin to the portion of each working circle in the basin.

These are prorated figures because the allowable cuts are determined for an entire working circle. From year to year, annual budgeted cutting will occur in different portions of the working circles. Thus, in a given year, the cut for a working circle that is partially inside the basin may occur on land in the basin while, in other years, there may be no cutting at all on that portion in the basin. The actual cut in any one year may also fluctuate widely with varying marketing conditions, as illustrated in figure 4.

Photo 6.--Timber growth and commercial value can be increased through thinning and pruning. SCS

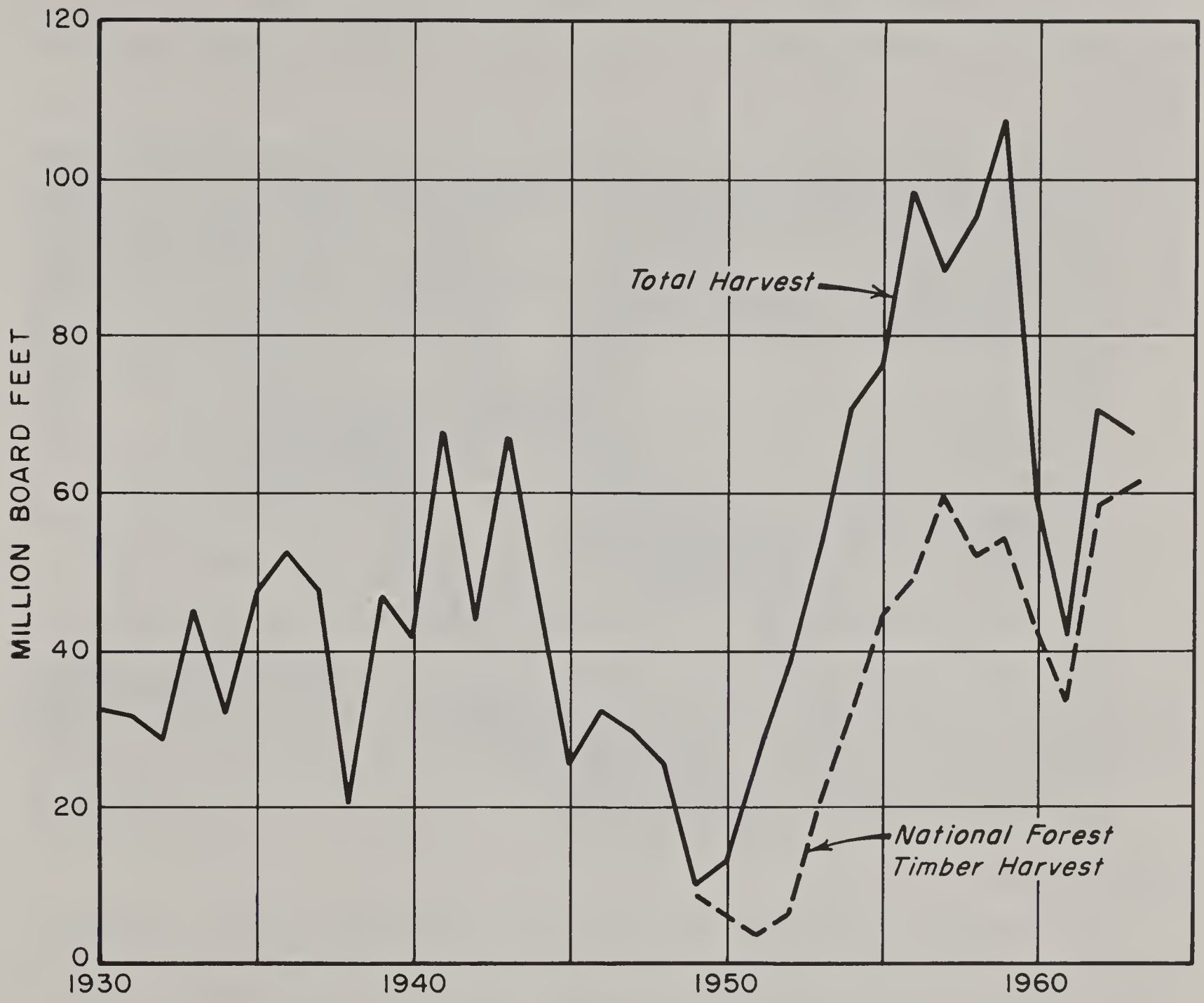


Figure 4

Allowable cuts are subject to recalculation at approximately ten-year intervals. Such factors as degree of wood utilization, rapidity of regeneration of cutover land, and accessibility of salvable dead timber affect the allowable cut. For instance, in recent years, increased demand for small logs, defective logs, low-valued species, and previously unmerchantable material has resulted in increased allowable cuts. Changing techniques in collection and evaluation of inventory data will continue to improve the basis for determining the allowable cut. Under intensified management, a gradual long-term increase in allowable cut is expected to be provided by intermediate cuts, closer utilization, decreasing mortality, and maintenance of optimum growth rates. Obtaining these objectives requires the active cooperation of timber industry operators--especially in logging to obtain adequate utilization and to protect the soil and residual trees from avoidable damage.

Other Ownership

Because of the rapid depletion of timber on private land, it is difficult to assign it a sustained-yield volume. For the immediate future, continued depletion may be expected with near exhaustion of private timber within, perhaps, twenty years followed by an extended period of little or no cutting while present young stands are attaining merchantable size. During this interim period, the timber supply for the basin will be almost entirely from public land; thereafter, timber production from private lands will be closely related to intensity of management. Under optimum management, an annual allowable cut comparable to expected forest growth, or 23 million board feet, might be expected; however, there are several current conditions in this basin that will tend to limit the extent of forest conservation practices on private land. These include:

1. The generally low productivity of much of the forest land.
2. The low market value for species other than ponderosa pine and the near absence of markets for small second-growth logs.
3. Rough topography which limits area available for thinning and other intermediate harvest operations.
4. High transportation cost for forest products because of the comparatively great distance to markets.
5. The relatively high value of forest land for forage production.

Improved markets for forest products may change some of these conditions, but private forest-land management is expected to remain on an extensive basis for some time; thus, a sustained production of 15 million board feet is thought to be realistic for these lands.

Forest-Range

The current forest-range condition varies from good to poor. A number of problem areas exist because of past customs, practices, and uses which, in some instances, contributed major damage prior to regulated grazing. Today's range manager and stockman working together have a challenge in restoring ranges to their potential production and they must share responsibility for sustaining a vegetative cover needed for soil and water resources.

A detailed discussion of the forest-range is contained in a later part of this report.

Wildlife and Wildlife Habitat

The management of the wildlife resource is a cooperative program between the Oregon State Game Commission and the landowner. The Commission has primary responsibility for protecting game, setting seasons, controlling harvest, restocking, et cetera, whereas the land manager, as in the case of the Forest Service or the Bureau of Land Management, is basically responsible for maintaining the habitat; however, the total program is one of joint management.

The wildlife resource, particularly big game, is very important to the economy of the basin. Hunting and fishing attract many people to the area. For instance, in 1964, there were 87,000 visits for hunting and fishing on National Forests in the basin; many of these people were from outside the basin. This accounts for almost half of the National Forest recreational uses.

Photo 7.--Mule deer often winter in mountain mahogany-type range. FS

Big Game

The big game species of the basin are primarily mule deer and Rocky Mountain elk. Surveys by the Game Commission indicate that populations of deer and elk have been increasing slightly over the past few years. Statistics of the Game Commission indicate the following data concerning big game harvest for 1962: 2/

	Elk	Deer
Percent of Hunters Successful	23%	72%
Number of Hunters	2,637	9,606
Harvest	632	6,943

2/ No attempt has been made to reconcile these figures with those shown for National Forest big game hunting.

The hunter-success ratio for both deer and elk in the basin is above the average for the entire state.

Summer big game ranges prevail at high elevations on forest land. With the coming of cold weather in October and November, the herds migrate to winter ranges. If the winter is short and not too severe, the animals will stay high on the south slopes near or within the lower forested slopes. If the winter is long and very severe, the animals will move to lower elevations in the valleys. Here they must compete with domestic livestock for feed. Heavy concentration of big game on winter ranges may cause overuse of the vegetative cover needed for soil and water resources. A shortage of suitable winter range is the most important limiting factor in big game populations in the basin.

Photo 8.--A successful hunter proudly displays his big buck.
FS

Conflicts between big game and livestock are not serious on summer ranges when requirements are evaluated and adequate allowance is made for game and livestock in determining carrying capacities of the ranges. To date, big game herds have not contributed significantly to deterioration of forested rangelands in the basin; however, populations could build up to damaging levels in the future if they are not controlled.

Other Game Animals and Predators

The major upland game-bird species are pheasant, chukar, mountain quail, and blue and ruffed grouse. The basin has only a small migratory waterfowl population because of lack of suitable habitat. Small game hunting, for rabbits and squirrels, attracts a relatively small number of hunters, mainly from the local area.

Several furbearing species including mink, muskrat, beaver, and raccoon are represented in the basin. The value of these animals trapped in 1963 was approximately $2,500.

Other wildlife species include coyote, bobcat, bear, porcupine, and, occasionally, cougar. Porcupine control is often necessary to keep damage to plantations and sapling stands within acceptable limits. Cougar populations in the basin have so declined in recent years that the species is in danger of extinction.

Anadromous Fish

At one time, the basin's streams provided fine spawning grounds for steelhead and salmon. Much of the spawning took place on Pine and Eagle Creeks. An area surveyed on Eagle Creek in 1962 revealed the number of salmon-spawning areas comparable to past years. Several of the streams have been surveyed for habitat conditions. The habitat of Clear Creek appeared to be even more productive than East Pine Creek. Construction of Thief Valley Reservoir on the Powder River blocked fish runs above this point.

Resident Fish

Many of the lakes and streams are popular with fishermen. Fishermen usually move to the higher elevations as the season advances and the lower streams become warm. As a result of a 1962 survey on Brownlee Reservoir, the Game Commission estimates that approximately 90 anglers used the reservoir each day and that over 19,000 anglers took approximately 150,000 game fish during the 1962 fishing season. About 85 percent of the use and harvest occurred prior to July 1. The Bureau of Commercial Fisheries recently completed a study showing the fishery to be declining rapidly because of low water quality, low oxygen content, proliferation of trash fish, and other causes.

Several of the lakes and many of the basin's streams are stocked annually with hatchery-raised trout. The demand for more good fishing waters is expected to increase in the near future.

The Game Commission has found it desirable to chemically treat some streams and lakes to reduce the numbers of trash fish and to increase the number and size of game fish. Unity Reservoir was treated in 1963. In 1964, it produced 270,000 rainbow trout and attracted 51,625 fishermen. 3/

3/ Oregon State Game Commission Bulletin, July-August 1965.

Photo 9.--Mountain lakes and scenery add to the attraction of the Powder Drainage Basin. FS

RECREATION

Outdoor recreation has always attracted many of the local residents. Hunting and fishing are parts of their pioneer heritage. The expanding population and increased urbanization in other areas have caused more people to seek outdoor recreation--sightseeing, hunting, fishing, picnicking, winter sports, and related activities. Better and faster transportation, higher family incomes, and increased leisure time have enabled people to travel farther for recreation and to spend more time and money. All of these factors have brought about an increase in the recreational use of the Powder Drainage Basin.

The basin has many areas that are attractive for recreational purposes. These include the rugged wilderness, the timbered mountains, and the sage-covered rangeland. Access to the Eagle Cap Wilderness is trails which have been constructed for both horsemen and trail hikers. No motorized vehicles or equipment are permitted in the Wilderness. In other forested areas throughout the basin, hikers, hunters, fishermen, sightseers, and others participate in various recreational activities throughout the year. Winter use is predominately skiing. The Anthony Lakes Ski Area provides a suitable skiing opportunity from December through March most years.

In 1962, it was estimated that the Brownlee Reservoir received over 6,000 visitor-days use by boaters during the boating season. Boating, other than with small fishing or row boats, was virtually unknown in this area until 1958 when the Brownlee Reservoir was filled. Since that time, boating has gained in popularity. The recreational opportunities at the reservoir are attracting people from as far away as The Dalles, Pendleton, and Boise.

Lakes have their boaters and fishermen; mountains have their skiers, riders, and hikers; and the rolling sage hills have their hunters. The entire basin is used at various times of the year for diversified forms of outdoor recreation.

Recreation Zoning

Because of the increasing importance of recreation in all areas of the basin, it is necessary to obtain management that will maintain the natural attractiveness of these areas. In addition to the parks, campgrounds, boat ramps, and other recognized recreational developments, landscape management zones are maintained around most potential and developed recreational sites around lakes, along recreation roads and along trails on the National Forests. These landscape zones vary in size according to the topography and the need for improving or protecting recreation values. Activities may be modified in these areas to enhance the environment for recreation. For instance, in certain areas, it is desirable to design timber harvesting with the objective of producing a healthy forest cover that is aesthetically pleasing.

Photo 10.--Landscape management zones are designed to provide pleasing scenery for the passerby.

It is also important to maintain some areas in a near-natural condition for wilderness recreation or for scientific study and observation. The 220,000-acre Eagle Cap Wilderness is one of the tracts classified by the Forest Service primarily for wilderness recreation. It contains spectacular alpine scenery with granite peaks mirrored in crystal clear, blue lakes. Sixty-four thousand acres of Eagle Cap Wilderness is in the Powder Drainage Basin.

Recreation resource is managed on the entire forest to achieve various results. The landscape management objective along roads, trails, waters, and development sites is to present a pleasant forest scene to the traveler. Special development, such as near Anthony Lakes, is designed to provide both summer and winter recreational opportunities. Boat rentals, fishing, hunting, or skiing are all possible in due season.

Trends in Use

Comprehensive recreation-use data for the entire basin are not available, but data from the Wallowa-Whitman National Forest indicate that more and more people are making two-day or longer trips for hunting, fishing, and camping. There has also been an upward trend during the past five years in one-day round trips for sightseeing and other outdoor activities. The data presented in table 7 show a 349 percent increase in recreational use since 1955. More significant, however, is that during this period hunting increased 578 percent (figure 5).

The Powder Drainage Basin has been, and still is, relatively remote from major population centers. Increasing populations in the northwest and in eastern Oregon, improved highways, and more leisure time will stimulate changes in recreational uses in this basin. The basin has many outstanding attractions such as Anthony Lakes, Oxbow Reservoir, and Brownlee Reservoir, the Wallowa Mountains, and portions of the Oregon Trail. Many of these are largely undeveloped now but development is planned.

The many miles of forest road is an important factor in encouraging increased recreational use of forest land. Completion of the forest-road system will permit development of recreational facilities in many areas that are now inaccessible.

The National Forest recreational use is expected to increase about 500 percent between 1960 and the year 2000. It increased 199 percent in the past five years (figure 6). Statewide recreational use of state parks and other land is expected to nearly double between 1960 and 1975 according to a study conducted by the State Highway Department. The two state parks, Farewell Bend and Unity Lake, have experienced a 216 percent increase between 1960 and 1963.

Visitors come from all parts of the state and nation. Recreation is a rapidly growing factor in the basin's economy as well as being vital to the well being of the people of the area. As this basin and other areas of Oregon become more heavily populated, the various recreational opportunities in the basin will become increasingly important.

Table 7.--National Forest recreation visits by primary purpose 1/

Primary purpose	Year									
	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964
	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number
Camping	10,742	13,360	12,400	11,770	17,055	14,525	18,068	22,572	23,210	27,190
Picnicking	10,342	9,318	10,615	10,520	13,636	31,180	32,804	35,708	41,111	37,908
Swimming	64	50	50	50	100	50	50	75	87	70
Winter sports	124	650	2,000	1,020	2,020	2,300	2,500	3,000	7,997	10,000
Hunting	11,160	10,383	9,881	9,880	18,570	24,738	39,745	44,000	59,750	64,560
Fishing	10,022	9,202	9,978	10,420	8,835	10,260	17,237	19,028	20,765	22,977
Hiking and riding	862	862	1,022	1,000	1,520	1,610	1,745	2,013	2,285	2,500
Canoeing	0	0	0	0	0	0	0	0	0	0
Organization camping	180	100	400	280	200	200	0	450	583	725
Wilderness travel	420	100	476	350	535	530	660	666	740	820
General enjoyment	7,454	6,148	6,728	5,894	5,660	6,660	9,996	12,466	15,112	19,020
Gathering forest products	150	150	160	450	2,070	2,510	815	1,640	3,133	3,050
Scientific hobbies	140	140	190	230	350	390	376	425	305	256
Other	2,740	240	240	0	660	120	305	799	1,523	1,067
Cross country travel	0	0	0	0	0	0	0	250	0	0
Motor vehicle travel (trail scooter)	0	0	0	0	0	0	0	477	0	0
Total	54,400	50,703	54,140	51,864	71,211	95,073	124,031	143,569	176,601	190,143

1/ National Forest Recreation Statistical Reports adjusted to basin by field party.

Changes in Primary Purpose of National Forest Recreation Visits,
Powder Drainage Basin, Oregon, 1955-64

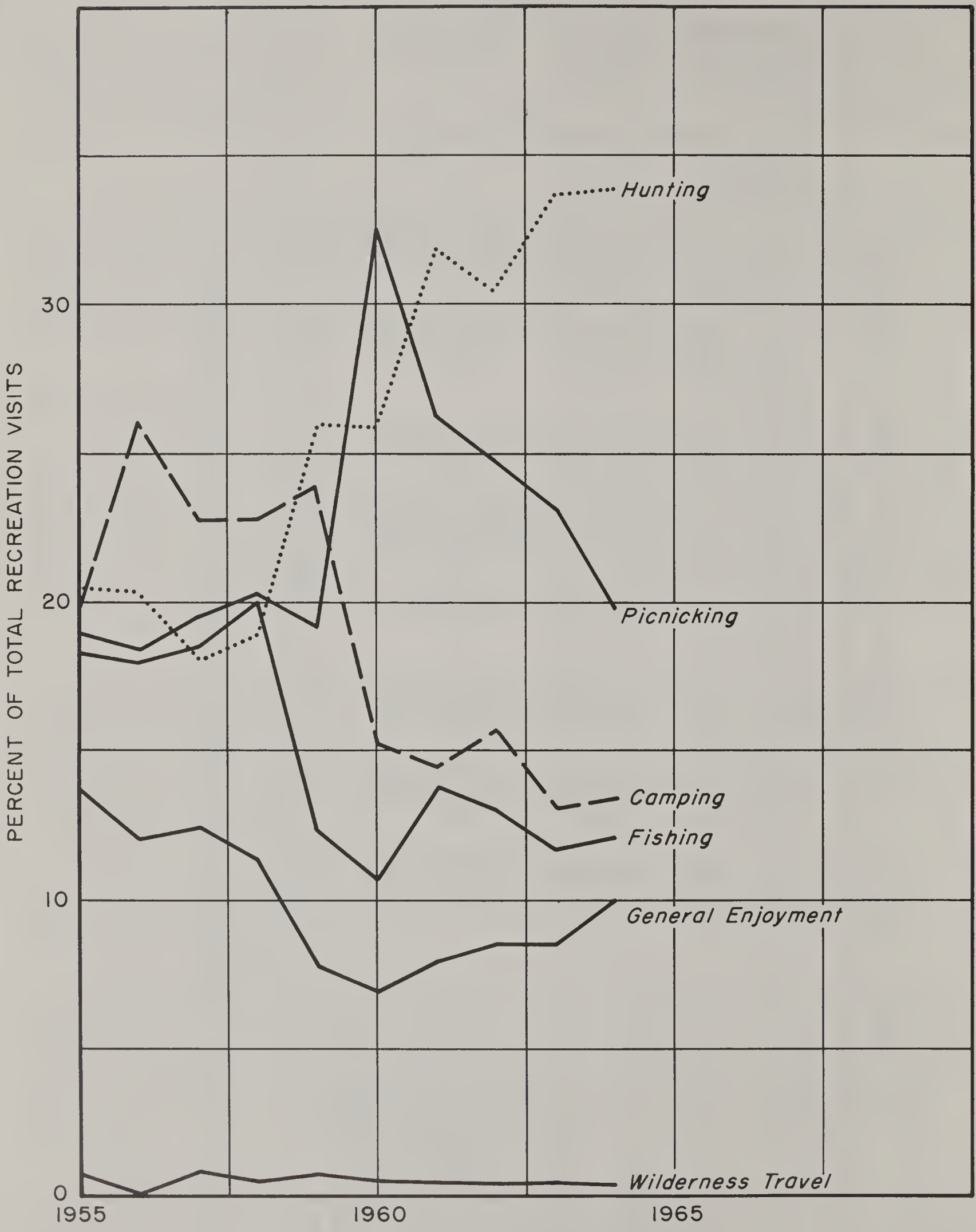
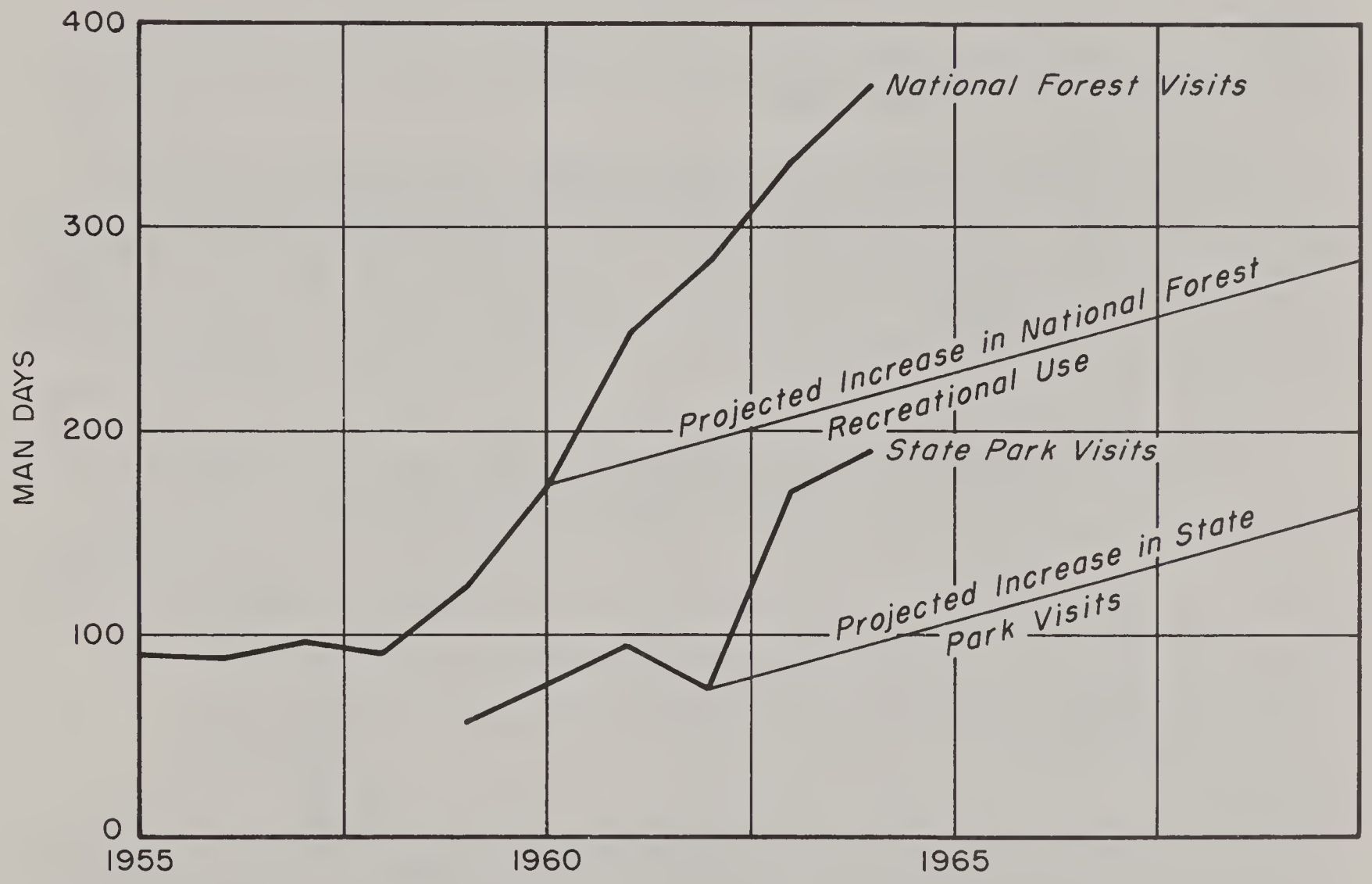


Figure 5

Public Recreational Facilities

The developed recreational facilities consist of state and privately owned parks and National Forest and public domain recreational areas. The National Forest facilities include 19 forest campgrounds with a total of 238 family units. 4/ These campgrounds range in size from 1 to 39 family units. There are some camp spots, used primarily by hunters, where the development has been limited to providing only sanitary facilities. These camp spots with minimum development are not included in the foregoing statistics. The maintenance and development standards of camp and picnic grounds

Recreational Visitor use of State Parks and National Forests, Powder Drainage Basin, Oregon, 1955-64 1/



1/ *National Forest Recreation Statistics, State Parks Attendance Records.*

Figure 6

4/ Includes table, fireplace, parking space, and tent or trailer space for camping units.

are currently being updated and improved. Particular emphasis is being given to securing and to providing adequate sanitation and potable water.

In conjunction with the Mason Dam project presently under construction in the basin, the Forest Service plans to develop 330 family picnic units and 205 family camping units. Also planned for development are two boat ramps, an administrative site, and a special-use agreement which will be entered into to allow the operation of a store, cafe, and boat-rental concession.

The Forest Service permits occupancy of suitable tracts of land for individual or public service purposes under special-use permits. There are two summer homesites in the basin. Approximately 30 recreation residence lots are used by private persons. Commercial concessionaire permittees operate winter sports and summer resort facilities at the Anthony Lakes Recreation Area.

WATER

Water Requirements on Forest Land

There are many kinds of water requirements, both consumptive and non-consumptive, on forest land but few quantitative estimates have been made of them. Estimates of certain consumptive water requirements on National Forest land in the basin are presented in table 8 as a sample of water use on forest land. While the estimated consumptive requirements are small, it is essential that they be considered in planning the development and use of water resources of the basin.

Table 8.--Estimates of some National Forest yearly consumptive water uses, Powder Drainage Basin, Oregon 1/

Use	Millions of gallons
Domestic:	
Administrative sites 2/	0.14
Recreation sites	0.97
Livestock	8.37
Industrial	288.00

1/ Includes only water used and should not be confused with amount stored to provide for this consumption.
2/ Does not include water obtained from municipal sources.

The largest single use of water on forest land is plant growth. This consumptive use is known as the evapo-transpiration process and is seldom measured.

Domestic. Domestic water uses with relation to forest land include the following:

1. Water used at administrative stations of both public agencies and private companies. Some stations are located in towns and are served by municipal supplies.
2. Water used at public recreation sites and at recreation facilities such as summer homes, organization camps, and resorts.
3. Water required for domestic purposes by other forest users including loggers, roadbuilders, stockmen, and local residents while working or living in forested areas.

Water requirements for all these uses are expected to increase as forest areas are used more heavily and managed more intensively. Domestic use in recreation can be expected to increase the most. A fivefold increase is expected in forest recreation in the Pacific Northwest in the next 40 years. Water use can be expected to increase at an even greater rate because of the emphasis upon installation of improved water systems and flush toilets in the recreation areas such as Anthony Lakes.

Recreation. Domestic water needs for recreation users have been mentioned. Other water requirements are of a nonconsumptive nature. These include habitat for fish and water for boating, swimming, and aesthetic enjoyment.

This use is expected to increase greatly. Any water development in the basin should make provision for recreation use which is now a recognized benefit under the provisions of P. L. 566 and other federal water development laws.

Livestock. Livestock water needs are expected to remain about the same on the rangelands in the future as indicated by recent range surveys. The grazing capacity will remain static or perhaps decrease unless significant progress is made to restore the ranges to their potential production.

Wildlife. Water requirements for wildlife on forest land include the following:

1. Water consumed.
2. Water required as environment for wildlife such as waterfowl and certain furbearers. Fairly uniform water levels must be maintained for some species, and water must be kept free of pollution.

Wildlife water requirements are expected to remain reasonably stable.

Fish Life. Water requirements for fish life include the water in streams and lakes that is a necessary environment for fish. There are certain water quality requirements pertaining to temperature, oxygen content, and freedom from pollution and turbidity which must be maintained if fish and the aquatic plants and animals they use for feed are to thrive. An important part of maintaining water quality is providing adequate streamflows and lake levels. When water levels are low, especially during summer months, the water temperature is likely to climb, oxygen level to decrease, and pollution to increase because wastes are not carried away promptly. Flow depths must be adequate and stream channels open so that fish can travel to

the spawning areas. Water and streambed conditions in the spawning areas must be suitable for each species.

Industrial. Water requirements for forest industries on forest land include the following:

1. Water for construction and maintenance of access roads.
2. Water for operation of timber harvesting equipment.
3. Water for storage and transportation of logs.

Water requirements for road construction and maintenance will probably decrease as the primary access-road system is completed and dust abatement materials other than water become more widely used for road maintenance. Water requirements for timber harvesting, storage, and transportation may increase as harvesting of second growth increases. Large quantities of small logs may be harvested as thinnings and log sizes will be smaller. This could result in an increase of water needed per unit of log production, but industry has been lowering water needs while increasing production in other processing phases. Generally speaking, water requirements for industry are not expected to change greatly in the near future.

Fire Control. Variable quantities of water are required for control of forest and slash disposal fires. Water must also be stored in ponds and tanks so that it is readily available when needed. The amount of water required for this purpose is not expected to change greatly in the future.

Watershed Management

A watershed manager, whether he is a logging superintendent, a rancher, a tree farmer, or a forest ranger, deals with all the resources of the drainage, but his primary aim should be to utilize them in such a way that maximum quantities of clear, usable water are supplied. Watersheds convert large amounts of rain and snow to streamflow. For example, in places where 18 inches of precipitation reaches the soil annually, a plot only 10 feet square receives and disposes of 4.7 tons of water each year. It is essential that he include control of erosion in his plan of management and that he think of water and soil as resources of value like trees and forage.

Roads. Improperly built or maintained roads can be a major source of silt in streams, but well designed, built, and maintained roads can have a relatively minor adverse effect on the watershed. Some points to be considered before building roads are listed below:

1. Plan the road system in advance of construction.
2. Learn to recognize and avoid trouble spots.
3. Avoid steep roads.
4. Provide adequate drainage.
5. Do not build roads in or near stream channels.
6. Build with a minimum of earth movement.
7. Keep road in good repair during use.

Logging. Erosion from logging can be diminished by improving skidding practices and by rehabilitating trouble spots afterward. Logging methods and equipment can play a tremendous part in preserving water quality. The following points should be considered:

1. Do not yard logs in stream channels.
2. Keep skid trails drained by directing the water into areas where the sediment can settle out.
3. Keep tractors on moderate slopes and use high lead or other cable systems on slopes over 45 percent.
4. Seed or plant erosive areas with suitable grass, shrubs, trees, et cetera to obtain a desirable cover.

Fire Prevention. Fire aggravates erosion by destroying vegetative cover which normally holds soil in place. Burned areas should be revegetated promptly to avoid soil loss. Loss of vegetation can be minimized in controlled burning such as slash disposal with good supervision and timing to avoid too hot a burn.

Grazing. Grazing, like timber harvest and fire, is an acceptable watershed practice only if excessive soil damage can be avoided. The following principles should be applied to grazing practice in the forested watersheds of the basin:

1. Forage should be moderately grazed.
2. Livestock should be kept off the range while it is still saturated from winter snow and rain.
3. A close watch on range condition to prevent overgrazing should be maintained.

Wildlife. Use of a watershed by wildlife is generally an acceptable management practice. Problems sometimes develop when game numbers become so large that forage is overgrazed to the point of denuding the vegetative cover. When this happens, excessive amounts of soil movement can occur. This is primarily a problem on winter range areas. This situation can be avoided by:

1. Taking into account wildlife when allocating forage to livestock.
2. Keeping game numbers in balance with the forage production.

These recommended measures for roadbuilding, logging, burning, grazing, and wildlife are aimed at prevention and control. Where they can be applied to the needs of each individual watershed, erosion can be kept within acceptable limits. The need for costly remedial measures in the future will be virtually eliminated.

Water Yield

A large percentage of the annual water yield from the Powder Drainage Basin comes from forest land. Forest land is vitally important in controlling quality, quantity, and timing of water yield. At low elevations, forest cover helps maintain soil conditions that encourage infiltration of precipitation. Trees, brush, and organic litter protect the soil from the eroding action of

rainfall. More water is percolated into the ground water storage for later gradual release instead of rapidly running off over the surface. At high elevations, forest cover helps to prolong melting of winter snowpacks which provide much of the late spring and summer flows in streams rising in the Wallowa and Elkhorn Mountains. Trees provide shade along rivers and streams helping to maintain water temperatures suitable for fish life.

Photo 11.--This sparkling mountain water will be used by the residents of Baker, Oregon. FS

Municipal Water

Baker and Sumpter obtain their municipal water from watersheds in the Wallowa-Whitman National Forest. These watershed areas are managed primarily for water production, but other uses are permitted. Because domestic water is so important, it is necessary that the watershed be managed so as to provide uniform flows of high quality water.

RANGE RESOURCES IN THE BASIN

INTRODUCTION

Over 1,600,000 acres of the Powder Drainage Basin are devoted to range use. Of this, 1,006,200 acres is rangeland and 607,400 acres is forest land. The range varies from open grassland in the stream bottoms and meadows to rolling grass-shrub types, to forested areas in the mountains. It is used by both domestic stock and wildlife. The range condition is as varied as its occurrence and use, but the major portion is classed as fair to poor on a scale ranging from excellent to very poor. The condition, use, and potential of the range resource will be discussed in this section while its contribution to the economy will be covered in the agriculture section.

RANGE TYPES

Native grasslands and meadows now cover the smallest area of the Powder Drainage Basin range types. Much of the original grassland is now irrigated cropland but, because hay is a major crop, this land is still very important to the rancher. The existing grasslands are generally in fair condition. The primary species are bearded bluebunch wheatgrass, Sandberg bluegrass, and Idaho fescue. This type is usually privately owned; however, there are scattered tracts of public domain.

The grass-shrub type covers the major portion of the range resource and is found in all but the forested portion of the basin. The primary grass species are downy chess (cheatgrass), Sandberg bluegrass, and bearded bluebunch wheatgrass, with large areas covered by big sagebrush and rabbit brush. This type provides most of the spring and fall range; however, some is grazed all year. Ownership is about evenly divided between private and public. Most of the public domain and some of the National Forest ownership is in this type.

The primary summer range is found in the forested, higher elevation portion of the basin. This type consists of open pine stands, grassy ridges, and openings in the forest. The primary forage species are pinegrass, elk sedge, and Kentucky bluegrass. Most of this type is within the Wallowa-Whitman National Forest.

Photo 12.--These cattle are grazing tall wheatgrass near the home ranch. SCS

RANGE CONDITION

Range use started in the 1870's with the settlement of Baker Valley when the cattle numbers became great enough to need other than meadow pastures. It was during this period that the first itinerant herds of sheep arrived. The pattern of use for fifty years was for large bands to be herded through the mountains closely cropping the vegetation from the ridges and meadows each year. Some of the ridges that were used as driveways thirty and more years ago can be easily recognized today by their lack of adequate vegetative cover.

Both the Bureau of Land Management and the Forest Service are conducting range condition and trend surveys. The condition classes in table 9 are based on surveys completed during the 1964 field season. Comparable condition information is not available for the other ownerships. As a rule, the areas with the longest history of overuse are in the poorest condition. Good management on areas with good soils and adequate moisture can and has, in some instances, overcome this early setback.

In addition to knowledge of the range condition, information on the trend of the range resource is vital to proper management. The surveys for both the Powder River Unit and Burnt River Unit of the public domain indicated that the trend was either static or downward. Results of range surveys on about half of the National Forest range show an overall static condition.

Photo 13.--Not all of the native range is bad. This bunchgrass range is in good condition. SCS

RANGE USE

Domestic livestock share the local range resource with large numbers of big game and other forms of wildlife. The federal agencies allow for this dual use when they decide on the number of domestic animals to be allowed on the range. Forest Service studies indicate that 50 percent and more of the available forage in some areas is utilized by wildlife. The Bureau of Land Management has assigned to wildlife approximately one-third of the public domain range resource.

The pattern of range use is quite stable from year to year. The cattle spend the winter on pastures near the ranch where they are fed hay to supplement what forage may be available. In the spring or early summer, they are turned onto the grass-shrub range from where the permitted stock are moved to their summer range in the mountains. In the fall, they are returned to the grass-shrub range where they remain until returning to the ranch to spend the winter. The same pattern is also generally true for sheep.

Both the Bureau of Land Management and the Forest Service issue permits to stockmen to graze cattle, sheep, and horses on the public lands. The permits authorize a given number of animals on an allotted area for a specified period.

Table 9.--Condition class rating of selected publicly owned range areas, Powder Drainage Basin, Oregon, 1964 1/

Condition class 2/	Wallowa-Whitman National Forest 3/	Powder River Unit (BLM)	Burnt River Unit (BLM)
	Percent	Percent	Percent
Excellent	0.6	...	...
Good	16.6	5.2	5.0
Fair	48.6	42.5	53.0
Poor	27.6	36.9	26.0
Very Poor	6.6	15.4	15.0
Inaccessible	...	...	1.0

1/ U. S. Forest Service and Bureau of Land Management data.

2/ A classification system for range conditions based on maximum forage production for domestic stock and wildlife. Excellent 80-100%; Good 60-80%; Fair 40-60%; Poor 20-40%; Very Poor 0-20%; Inaccessible, unavailable to livestock.

3/ About one-half of the National Forest range areas.

The Forest Service permits cost the rancher about 55 cents per animal unit month and are issued on a preferential basis which was established when the grazing land was first organized into specific allotments. A grazing preference, continuously used, remains with a ranch indefinitely unless it is waived or abandoned. When base ranch property is sold, the National Forest grazing preference is also transferred and enhances the value of the base property; however, all preferences are contingent upon the permittee maintaining his base property in order to support the permitted livestock during the time they are off the forest range. Range improvements such as fences and water developments may be constructed by either the Forest Service or by the permittee, who receives no direct monetary compensation for his efforts; however, these improvements result in better range utilization. In 1964, there were 46,500 animal unit months of use permitted on National Forest ranges for cattle.

There is a tremendous potential for producing livestock forage on public domain, National Forest, and private lands in the Powder Drainage Basin.

Reductions in permitted numbers of livestock have been necessary in some problem areas. Reduction has been gradual and planned well in advance. The challenge to the range manager and the stockmen is to obtain joint management that will adequately protect range, soil, and water resources. Partnership effort in planning and execution of range use plans, range vegetation, adequate control of livestock movement, installation of improvements (fences, water, et cetera), should eventually result in restoration of much of the range to its original productivity.

Grazing permits at a cost of 30 cents per A.U.M. are issued by the Bureau of Land Management which restricts the number of domestic animals grazing on public domain in the basin. These permits are dependent upon ranch holdings, and without them, a ranch is limited in the number of cattle it can support.

Photo 14.--Fences have permitted this rancher to determine the grazing use of the pasture on the left. The pasture on the right has been heavily used. SCS

Table 10.--Animal unit months of public domain range use, Baker County, Oregon, 1955-1964 1/

Year	Cattle AUM's 2/	Sheep AUM's	Total AUM's	Number of operators
1955	76,044	6,309	82,353	...
1956	73,443	6,822	80,265	...
1957	70,667	6,408	77,075	...
1958	74,086	5,599	79,685	...
1959	72,233	5,475	77,708	...
1960	70,452	5,785	76,237	222
1961	71,650	4,890	76,540	217
1962	72,132	4,064	76,196	226
1963	74,157	4,868	79,025	232
1964	66,748	5,737	72,485	205

1/ Annual Grazing Statistical Report, Baker District, BLM.
2/ An Animal Unit Month (AUM) is the feed required for an animal unit (cow and calf or five ewes and lambs) for one month.

RANGE IMPROVEMENT

It has been pointed out to local ranchers and land managers that large areas of range are producing only one-third to one-tenth of their potential under proper management. 1/ There are several reasons for this, but past practices which have allowed the invasion of nondesirable species account for most of the current problems.

Large areas, almost 70 percent of the range in the basin, are covered with big sagebrush and rabbit brush. These shrubs greatly reduce the growth and availability of usable forage plants. Removal of sagebrush is essential to the increase of forage production on these ranges. The data in table 11 which is from range improvement trials in various parts of Baker County indicate that after sage removal only there was a 250 percent increase in forage production overall with several areas showing a 300 percent increase. When the sage was removed and the area was seeded to higher yielding grasses and forage plants, the average increase was 880 percent with some areas experiencing a 1,000 percent increase.

Table 11.--Range demonstration yield comparisons, in pounds of forage, Powder Drainage Basin, Oregon, 1963-64 1/

Location	Native		Sage removed		Seeded	
	1963	1964	1963	1964	1963	1963
Virtue	89	64	211	193	651	560
North Powder	123	96	302	228	811	756
Sutton Creek	211	189	513	463	1,782	1,569
Huntington	198	156	586	472	1,738	1,563
Durkee	203	191	614	531	1,833	1,707
Bridgeport	232	202	694	599	2,332	2,004
Sparta	271	246	816	754	2,776	2,308

1/ Bureau of Land Management data.

A pilot project for range improvement has been started in the Keating area. This area was selected because of local interest, because many ranchers had individual range improvement plans and because the federal agencies were also planning range improvements in the area. Because this is an important big-game area, the Game Commission and sportsman's groups met with the ranchers and public agencies during the planning phases. The project area involves 290,000 acres and includes 50 operating units. Sixty percent is privately owned.

1/ Annual Report of Baker County Extension Staff, September 1964, p. 56.

Photo 15.--Sagebrush dominates plant growth on this rangeland making little other forage available. The area in photo 16 looked like this before treatment. SCS

One unique feature of this project is the formal cooperation between ranchers and the Bureau of Land Management. Under this arrangement, the lands in each range unit are treated at the same time regardless of ownership. This feature is important because of the checkerboard pattern of landownership in much of the rangeland and because of the importance of treating the whole management unit at one time.

Another feature which encourages the ranchers to participate is the special classification given to this project area by the ASCS committees, both local and state. This provides for 80 percent of the cost on private land to be shared by the Agricultural Conservation Program. Eleven thousand dollars was allocated the first year with a $2,500 limit to an individual rancher in any year.

The program calls for approximately 90,000 acres of sage removal by either plowing, spraying, or burning. This area, along with an additional 50,000 acres, will be seeded. The areas will be fenced into pastures to control grazing use; water developments will be installed; and the treated areas will be protected from grazing for two growing seasons.

Photo 16.--This area is in its second growing season following sagebrush burning and drilling to crested wheatgrass. SCS

The first step involved controlled burning of 2,000 acres of private and public land followed by the seeding of adapted grasses. Coordinated with the controlled burning was the development of water facilities and the protection of willows and other stream-bottom shrubbery for big-game cover. After burning and seeding, the area was fenced to control use and to provide for the establishment of the grass seedlings.

The Bureau of Land Management range management plan indicates that the Powder River Unit "is the one area in the district that has a potential overall to show tremendous increases in vegetation, through either management or artificial means such as seedings and sprays." Some of the public domain areas that have been seeded following wildfire would seem to substantiate this belief.

As brought out in table 11, all areas in the basin do not respond to treatment in the same amount, but range improvement through sage removal and good management practices will increase forage production. Range with good vegetative cover provides good watershed protection and contributes to more uniform flows of higher quality water.

PROTECTION

Protection of range resources from fire is shared by the Bureau of Land Management, the Forest Service, the State of Oregon, and rural fire-protection associations which cooperate with these agencies. Federal, state, and local agencies also participate in coordinated pest control programs.

Some formal agreements are in effect which provide for public and private owners to fight all fires within the area without regard to landownership or cross-billing for costs. There are several fire-tool caches located throughout the basin, and several summer fire guards are available in addition to the fire crew at the Baker yards.

The man-caused fire problem is more and more the result of uses other than ranching. Several miles of firebreak have been constructed along the major highways; signs are being posted along the reservoirs and other public use areas to alert recreationists to the danger; and cooperation with the railroad is continuing in order to reduce railroad-caused fires.

Pest problems are associated with certain plant species. In addition to sage and rabbit brush, Medusa head rye grass is gaining a foothold in the eastern portion. This annually infests approximately 60,000 acres and is of little or no forage value. In Baker County, the infested area is mostly low-producing scabland that is relatively free of sagebrush. Several agencies are cooperating in an effort to control this pest.

The amount of suitable vegetation on the ground throughout the grazing season has a major influence on how much of the water is put to productive use, how much evaporates, and how much runs off. Consequently, the first consideration in any plan of management designed to make the most effective use of the available water is the intensity of grazing use.

The grazing use should be guided with the objective of securing adequate vegetation on the ground at all times, consistent with high forage production and sustained livestock gains. The proper intensity of use will usually not only leave more vegetation on the ground but, by saving more water, will result in higher forage yields and, consequently, more rapid livestock gains and a greater net return. 2/

2/ Management of water on Western Rangelands, Water-1955 Yearbook of Agriculture, USDA 1955, p. 416.

AGRICULTURE IN THE BASIN

LAND USE FOR AGRICULTURE

Grazing is the dominant land use in the Powder Drainage Basin. Approximately 78 percent of the basin is grazing land--29 percent of this amount is grazed forest land and 49 percent is rangeland. Cropland comprizes about 9 percent of the basin; nongrazed forest land, 8 percent; and other land--farmsteads, urban areas, water areas, roads, and nonusable land--, 5 percent. Agricultural land use is presented in table 12.

Grazing Land

The grazing resource forms the basis for agricultural organization and production. Livestock are grazed on rangeland and forest land for about 7 months of the year and the forage from hayland and pasture land is used for winter feed and supplementary summer forage. The grazed forest- and rangeland resource ownership, condition, use, and potential were discussed in a preceding section of this report. Forage production from rangeland could be increased substantially through various range management practices and a cooperative range improvement program. If the carrying capacity of the range resource can be increased, a corresponding increase in winter feed will be needed for the additional animals. This feed would probably be supplied by expanding production from irrigated pasture and hay lands.

The forage produced on cropland pasture and hayland complements the forage produced on the extensive grazing lands. Approximately 140,000 acres or 85 percent of the harvested or pastured cropland is used to produce forage. About 117,000 acres or 60 percent of the total cropland acreage used to produce forage is developed for irrigation (table 12).

Irrigated pasture provides the major summer feed for dairy cattle, farm flocks of sheep, and supplementary feed for range livestock. About 48,000 of the 62,000 acres of pasture in the basin are irrigated.

Statistical data on pasture productivity are not available; however, since almost all forage produced in the basin counties is utilized locally by livestock, forage productivity should be reflected by the number of animal units on hand. Animal units are used to permit addition of various types of

Table 12.--Agricultural land use, Powder Drainage Basin, Oregon, 1964 1/

Land use	Land area		
	Irrigated	Nonirrigated	Total
	Acres	Acres	Acres
Grazing land:			
Forest	0	607,400	607,400
Range	0	1,006,200	1,006,200
Total	0	1,613,600	1,613,600
Cropland:			
Forage crops	117,000	23,000	140,000
Pasture	(48,000)	(14,000)	(62,000)
Alfalfa hay	(30,000)	(3,000)	(33,000)
Mixed clover-grass hay	(11,000)	(2,000)	(13,000)
Wild hay	(24,000)	(3,000)	(27,000)
Other hay and silage	(4,000)	(1,000)	(5,000)
Wheat	8,000	2,000	10,000
Barley	6,000	2,000	8,000
Other small grain	2,200	800	3,000
Seed crops 2/	900	600	1,500
Potatoes and sugar beets	600	0	600
All other crops	300	400	700
Fallow and idle	0	32,200	32,200
Total	135,000	61,000	196,000
Total agricultural land	135,000	1,674,600	1,809,600

1/ Compiled from data collected by the USDA River Basin Survey Staff, the U. S. Census of Agriculture, and Baker County Annual Extension Report, 1964.
2/ Includes alfalfa, clover, grass, and potato seed crops.

roughage-consuming livestock. 1/ Animal units are a valid measure of forage productivity over time only if inshipments of feed are similar for the time periods used. Census data indicate that the amount spent for purchase of feed in Baker County was about $780,000 in 1959 and $719,000 in 1954 as compared to about $1 million in 1949. Therefore, it appears that if any changes are taking place, it is in the direction of more self-sufficiency in producing feed for livestock. Another limitation of using animal units as a measure of forage productivity is that changes in animal production per head are not reflected. Even though animal units do have these limitations, they can be used as a rough measure of forage production.

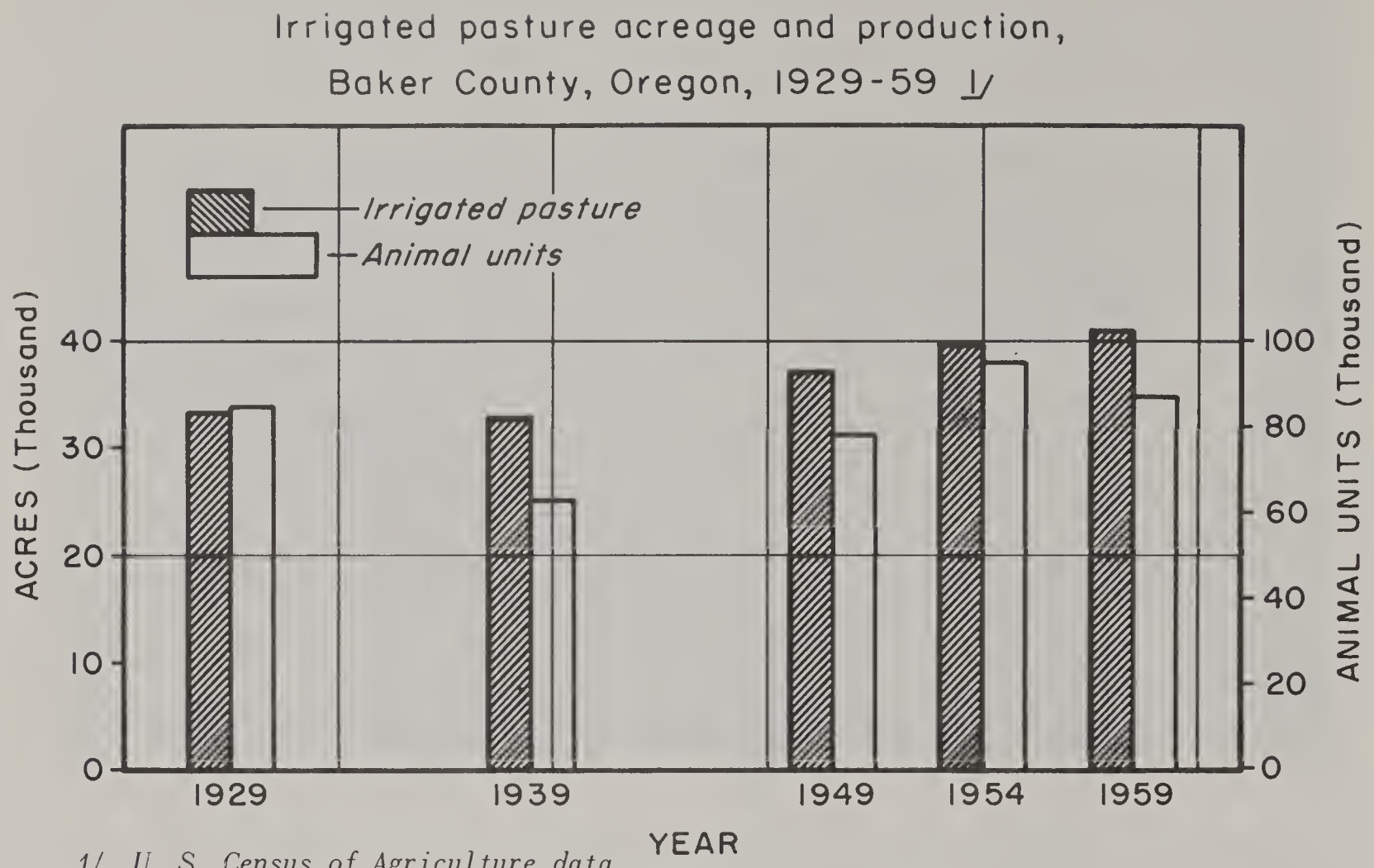
1/ Factors used to convert livestock into animal units are: 1 cow = 1 AU; 1 sheep = .2 AU; 1 horse or mule = .8 AU.

Photo 17.-- Rangeland is the most extensive use of land in the basin. SCS

It appears that forage production from irrigated pastures has been a major source of feed for the increasing numbers of livestock in the basin. As indicated later in this report, forage production from hayland has changed very little since 1939. At the same time, rangeland conditions have improved somewhat but this has been offset by a decrease in grazing permits on public land. A period of years of limited use of rangelands is required before forage production can be increased significantly. This has led to more reliance on forage from irrigated pastures. The relationship between total roughage animal units and acres of irrigated pasture indicates that the increase in animal units has been accompanied by a corresponding increase in irrigated pasture (figure 7).

Forage Crops

The most important hay crop is alfalfa. Production from the 33,000 acres of alfalfa accounts for about half of the total hay produced in the basin. Through the years, about 30,000 acres in Baker County have been utilized for producing about 75,000 tons of alfalfa hay annually (figure 8). From 89 to 96 percent of the alfalfa produced came from irrigated land (table 13). The average yields from irrigated land were about three-quarters of a ton higher per acre than for dryland. It should be noted that the figures in table 13 represent average yields for Baker County and include a wide range of soil and water-supply conditions. Water supplies are limited



1/ *U..S..Census of Agriculture data.*

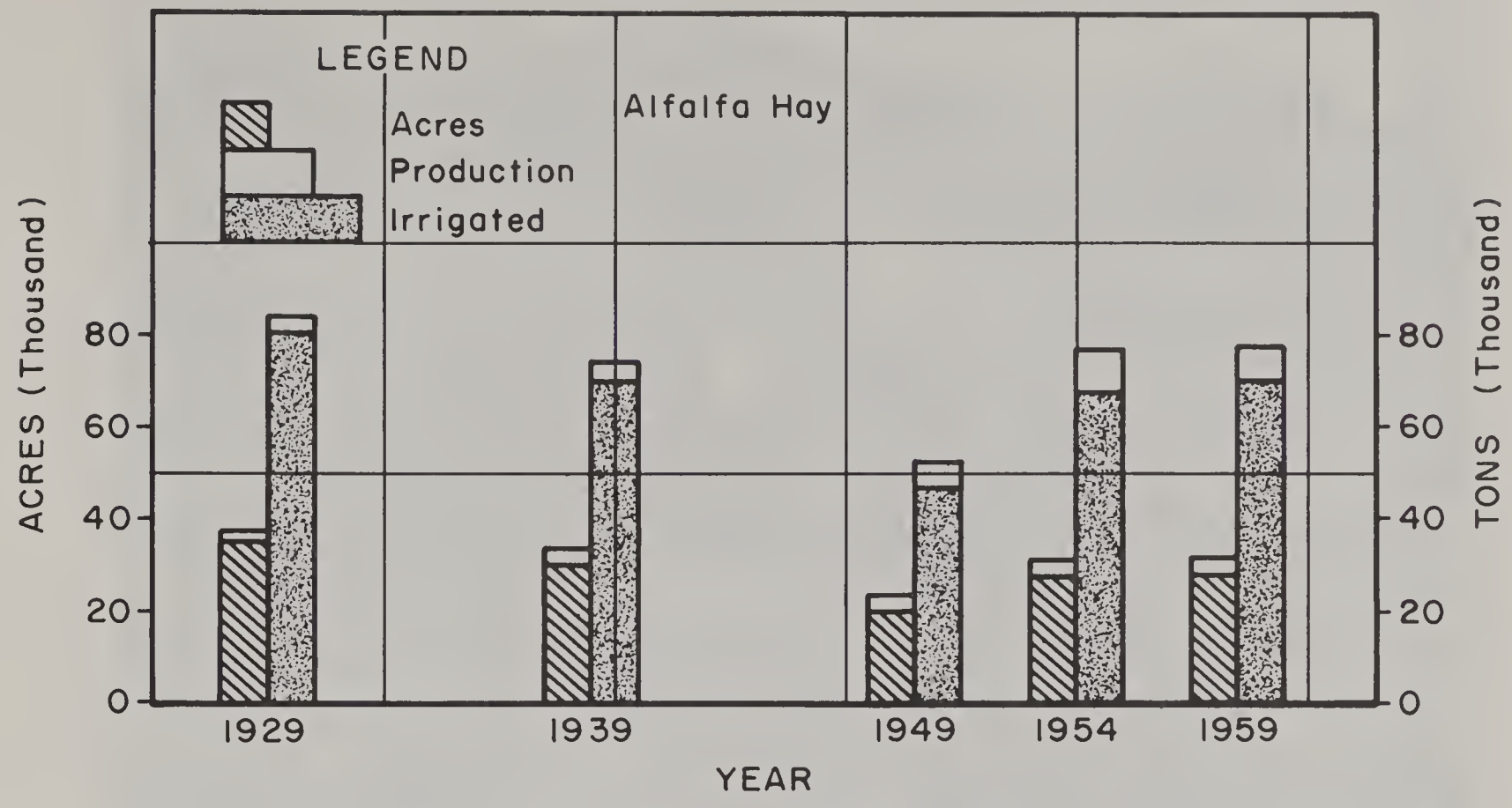
Figure 7

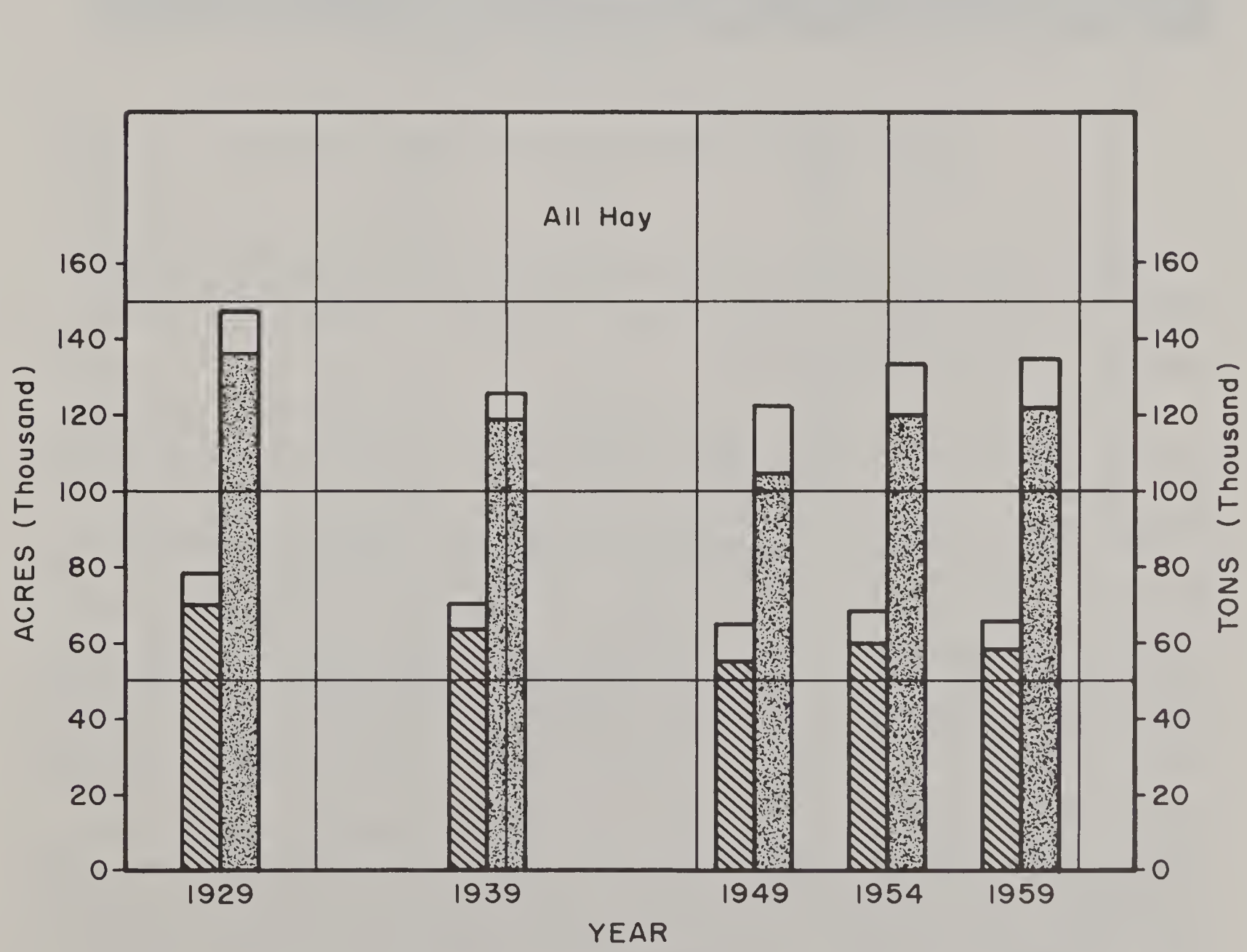
in most areas and often only one or two cuttings of hay are possible. Yields of 8 tons per acre have been produced on the better soils with adequate irrigation water.

In addition to alfalfa, 13,000 acres of clover and grass mixtures and 27,000 acres of native meadow were cut for hay. The 5,000 acres of "other hay and silage" in table 12 consist of small grain and other crops cut for hay, grass silage, and corn silage. In 1959, grass silage was cut from 849 acres in Baker County and corn silage was cut from 180 acres.

Although yields from clover and grass mixtures and native meadow are lower, costs of production are also less than for alfalfa. Much of this land is located in narrow strips along streams where irrigation is accomplished by wild flooding or "water spreading". Permanent diversion ditches are installed and the streamflow is applied with little supervision. In the past, from 84 to 89 percent of all hayland was irrigated, and production from irrigated land accounted for 87 to 94 percent of the annual hay crop. Hay yields from irrigated land in Baker County have averaged from one-half to three-quarters of a ton per acre higher than from dryland (table 13). The acreage used for producing hay has remained at about 65,000 acres since 1939 and the annual hay production has been about 130,000 tons (figure 8).

Hay acreage and production, Baker County, Oregon, 1929-59 1/





1/ *U. S. Census of Agriculture data.*

Figure 8

Photo 18.--This irrigated alfalfa-brome hay field is located in the northern section of the Powder Drainage Basin. SCS

In addition to producing hay, the hayland is often pastured. The decision of whether to pasture or to cut for hay is based largely on the availability of irrigation water, range conditions, and the need for hay reserves in any particular year.

Forage production has become the major use of cropland for several reasons. First of all, the number of alternative crops that can be successfully grown is limited by climatic conditions. The average frost-free growing season is only about 160 days. Cool nights also inhibit the growth of many crops. Perhaps of more importance is the climatic variability. Frost can occur any month of the year. The shortest growing season in Baker Valley was about 81 days and the longest was 181 days. Another climatic limitation is precipitation. Irrigation is generally necessary to successfully produce any tillable crop. The average annual rainfall in the major agricultural areas varies from 11 to 15 inches. A further limitation is the availability of water supplies for irrigation. Natural streamflow is the source of water for a major part of the irrigated land and water is usually not available for much of the land after the first of July. Since water supply varies considerably from year to year, even those landowners who hold the older water rights cannot depend on a full water supply each year. The combination of a generally short supply of water and of the variability of supply from year to year is not conducive for the growing of most tilled crops. Forage crops are more tolerant and adjust more easily to these

Table 13.--Crop yields, irrigated and dryland, Baker County, Oregon, 1929-1959 1/

Crop and year	Yield per acre		Percentage of acres irrigated	Percentage of production from irrigated land
	Irrigated	Dryland		
	Tons/acre	Tons/acre	Percent	Percent
Alfalfa hay:				
1959	2.51	1.84	87	90
1954	2.44	2.12	87	89
1949	2.37	1.61	85	89
1939	2.31	1.43	94	96
1929	2.35	1.72	94	95
All hay:				
1959	2.08	1.82	88	90
1954	1.99	1.63	88	90
1949	1.90	1.51	84	87
1939	1.86	1.15	91	94
1929	1.94	1.31	89	92
	Bu./acre	Bu./acre		
Wheat:				
1959	45.7	24.2	63	76
1954	40.9	25.9	26	36
1949	26.4	15.0	58	75
1939	28.4	15.6	71	82
1929	29.8	16.4	69	80
Barley:				
1959	36.4	25.6	48	57
1954	39.9	25.6	52	63
1949	31.4	30.0	66	67
1939	33.1	28.4	76	78
1929	38.0	34.1	86	87

1/ U. S. Census of Agriculture.

conditions. If water supplies are short, it does not mean the complete loss of a crop but a reduction in production. If water supplies are larger than average, the additional forage produced may be stored as hay for use in lean years; thus, forage crops are better adapted to the variable water supplies than most other crops.

The second reason why forage crops are favored by farmers in the basin is because a complementary relationship exists between the use of rangeland and the use of pasture and hay lands. Forage from rangeland can be more efficiently utilized if adequate forage is available from other sources as herd size can be maintained at a higher level. In addition to serving as a

source of winter feed, irrigated pasture and hay lands provide a feed reserve for winters that are longer than usual and dry years when range forage is inadequate.

Another reason why forage crops dominate others is the lack of local markets and the distance to marketing facilities. Livestock markets are well established in the area; however, marketing facilities for most crops are located outside the basin. For example, potatoes and sugar beets must be shipped to Ontario for processing; milk is shipped by bulk tank to Idaho. Because of the added transportation costs, farmers in this area are at a disadvantage over others located closer to the marketing facilities.

Finally, livestock production has become a tradition. Ranchers are reluctant to change their operations because of either a lack of knowledge of the alternatives or a lack of interest in the alternative, or both.

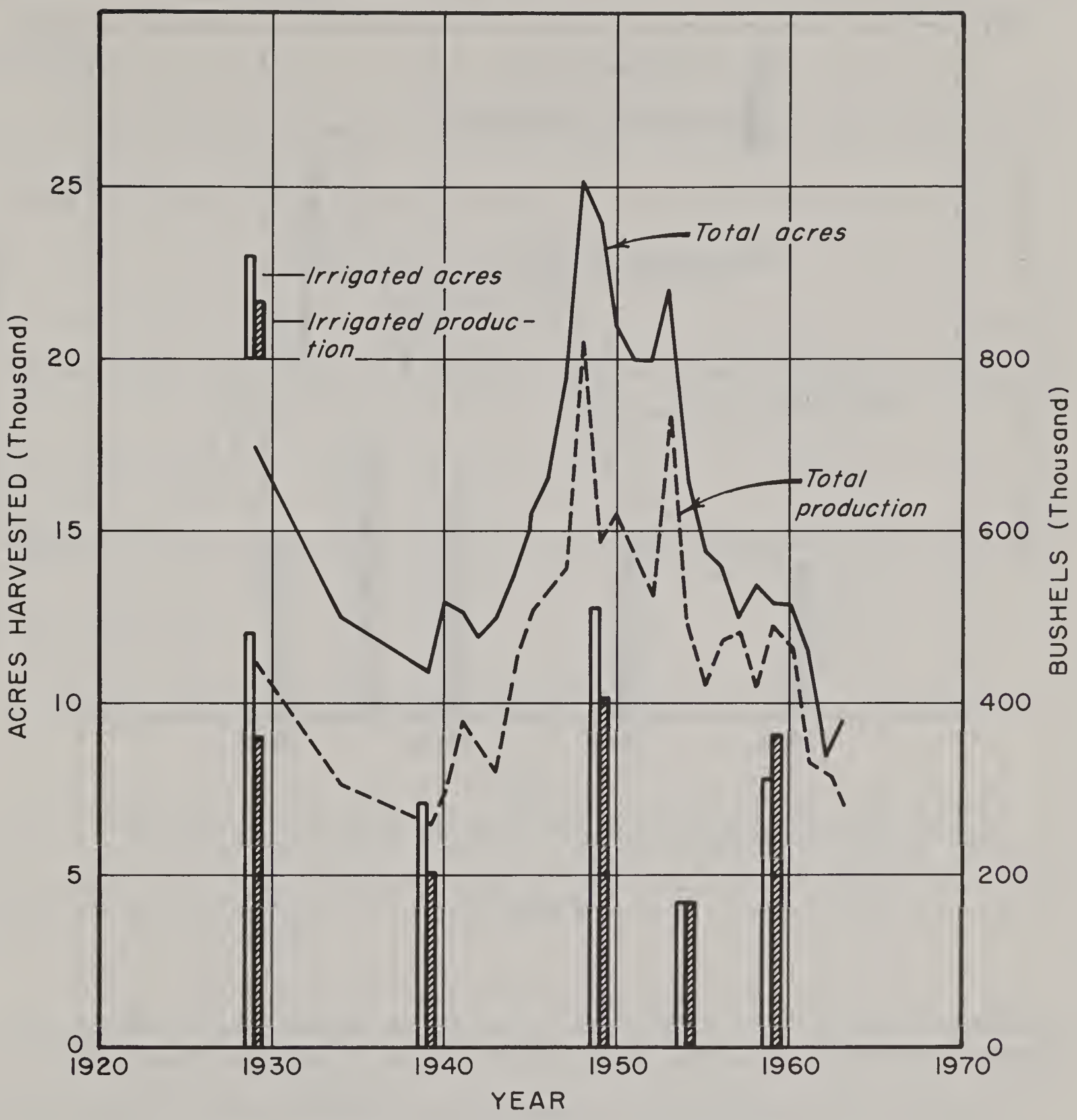
Other Crops

Occupying 13 percent of the harvested or pastured cropland acreage (table 12), small grains are the most widely grown tilled crops in the basin. Small grains are used in rotation with pasture and hay as a source of feed or as a cash crop. Wheat, harvested from about 10,000 acres in 1964, was the most important single crop grown on cultivated lands. The acreage harvested for wheat has been decreasing since 1949 when a record 827,000 bushels were harvested in Baker County (figure 9).

The percentage of wheat acreage that is irrigated varies considerably from year to year as illustrated by table 13. This reflects the high variability in water supplies for irrigation from year to year. Census data indicate that through the years average wheat yields from dryland in Baker County were about half as high as those from irrigated land. In recent years, yields have increased significantly with the adoption of Gaines, a new high-producing variety of wheat, and with the use of more commercial fertilizer. Fertilizer was applied to about half the wheat acreage in 1959. The percentage of wheat produced on irrigated land has ranged from 36 to 82 percent of the total production. Winter wheat is gradually replacing spring wheat and about 70 percent of the wheat acreage is winter wheat.

Barley is the second most important grain crop in the basin. It competes with wheat and has been planted in lieu of wheat when wheat acreage has been restricted by government programs. About 8,000 acres of barley were harvested in the basin in 1964. The trend in acreage harvested for barley has been downward since 1957 (figure 10). The percentage of barley produced from irrigated land has varied by census years from 57 to 87 percent. Average yields for barley have been from 1 to 14 bushels more on irrigated land than on dryland in past census years (table 13). Unlike wheat, barley yields have not increased in recent years.

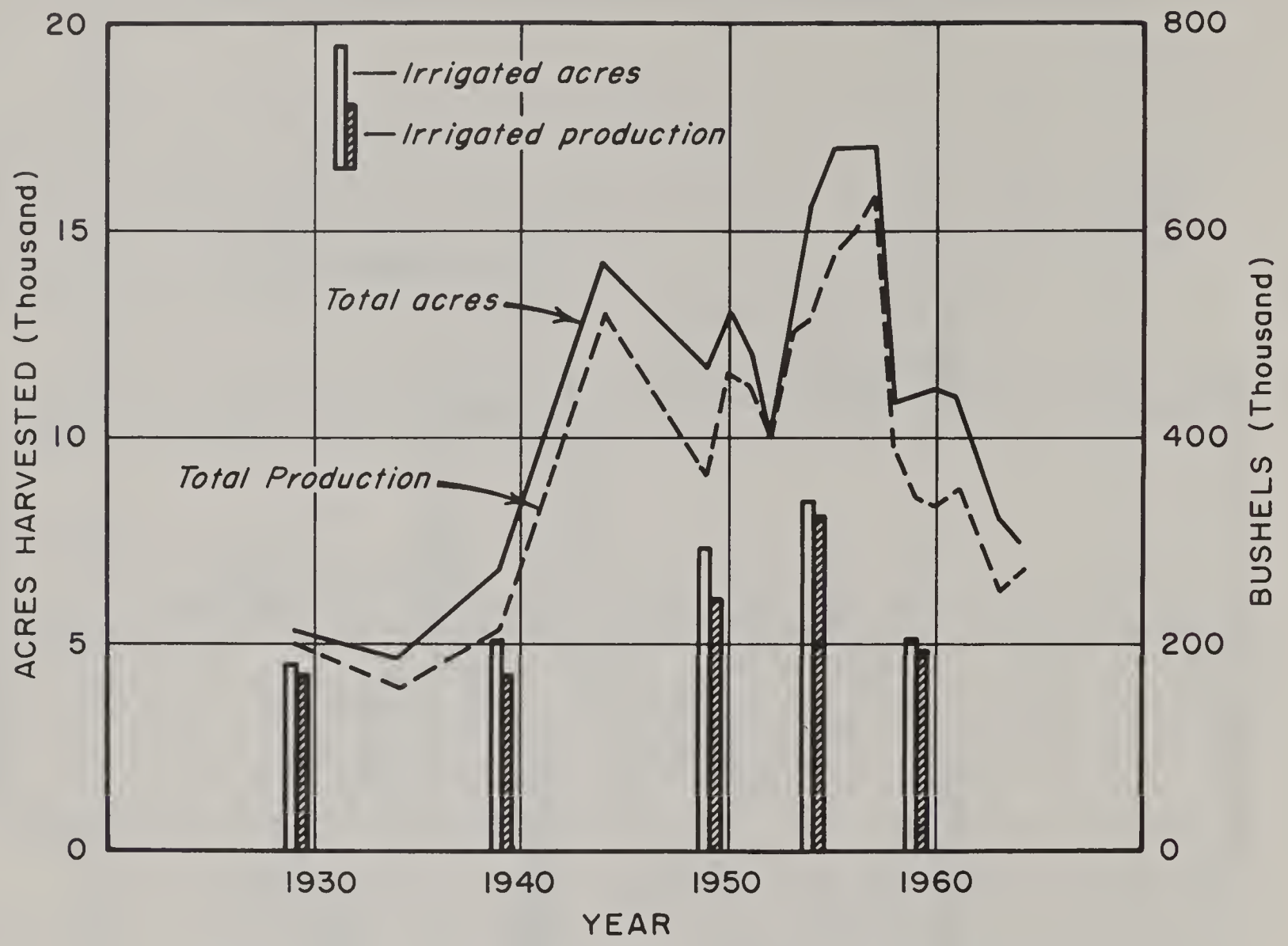
The 3,000 acres of other small grains raised in the basin include oats, rye, corn, and other mixed cereal crops that are used locally for feed.



1/ U. S. Census of Agriculture and Statistical Reporting Service data.

Figure 9

Seed crops of alfalfa, clover, and potatoes were raised on about 1,500 acres in 1964. Alfalfa and clover seed was harvested from about 600 acres and potato seed and sugar beet seed were produced on 800 acres. The climate and the remoteness from other agricultural areas are favorable for growing seed crops. The dry summers facilitate seed setting and harvesting. Because



1/ *U..S..Census of Agriculture and Statistical Reporting Service data.*

Figure 10

isolation of fields is possible, the problems of disease and contamination by other varieties are not as acute in the basin as in some other areas.

Potatoes and sugar beets were grown on 400 and 200 acres, respectively, in the basin in 1964. Average yields were 9.6 tons per acre in 1959 and 10.1 tons per acre in 1954. Sugar beets have never been grown extensively in the basin. Beet yields averaged 15.8 tons per acre in 1954 and 17.1 tons per acre in 1959. Both potatoes and sugar beets require a full season supply of irrigation water.

Other crops grown in the basin include small acreages of peas, tree fruits, berries, and vegetables.

CHARACTERISTICS OF AGRICULTURE

Livestock

The basin's agricultural land provides the forage base for 45,500 stock cows, 60,400 calves and feeders, 55,000 sheep, 2,700 milk cows, and 3,000 horses and mules (table 14).

Table 14.--Livestock and poultry, Baker County, Oregon, 1964 1/

Type of livestock	Total
	Number
Stock cattle	45,500
Calves and feeders	60,400
Milk cows	2,700
Sheep, ewes over 1 year	25,000
Lambs	30,000
Hogs	5,600
Horses and mules	3,000
Chickens on hand	20,000

1/ Baker County Annual Extension Report, 1964.

Trends in the number of animals are shown in figure 11. The general trend is for increased numbers of beef cattle and fewer milk cows, sheep, and horses. The total number of animal roughage units decreased in the 1930's but has been increasing gradually since 1940. The number of dairy cows has decreased by four-fifths since 1930. The number of sheep and lambs is about one-fifth the 1930 level.

Several factors indicate that beef production will continue to be the most important agricultural enterprise in the basin. Due to their remote location, farmers in the basin are at a disadvantage for marketing most products other than range livestock. A further disadvantage is the short growing season which limits the types of crops that can be grown.

The beef cattle enterprise is well established in the basin. There is no alternative for using rangeland other than for grazing livestock but, in order to utilize the range resource adequately, supplementary forage is needed. Livestock are usually kept on rangeland or grazed forest land for about seven months of the year and forage from irrigated pasture and hay lands is used to carry them the other five months.

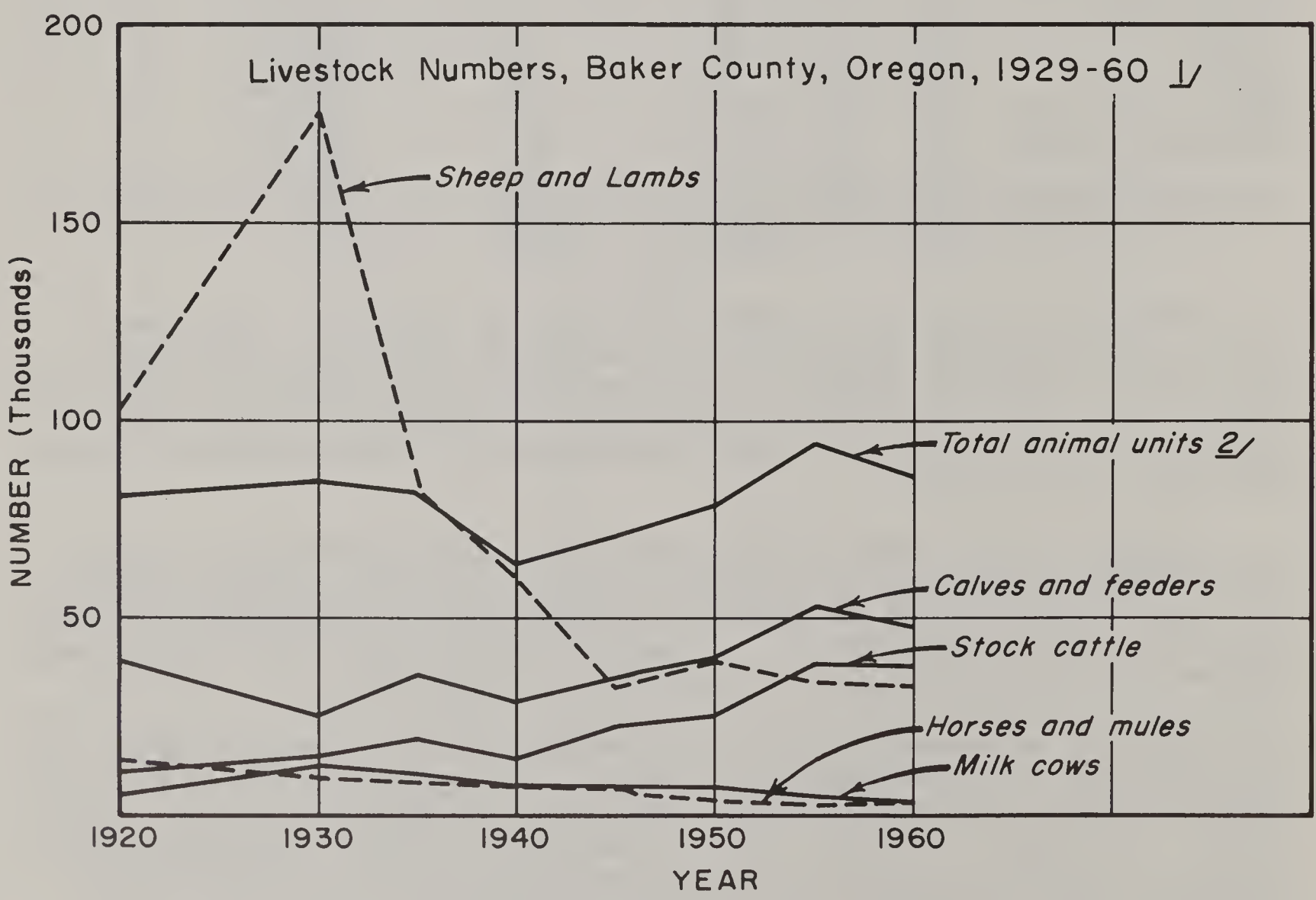
Stockmen and managers of public rangeland are cooperating in efforts to increase the productivity of this resource. As the carrying capacity of rangeland is increased, pressure will also increase for more winter forage. Unless price relationships change drastically, future use of land and water

resources for agriculture will be primarily for the further expansion of the beef cattle enterprise.

The number of large bands of range sheep has decreased because of the increase in costs of labor for herding and caring for the herds on the rangeland. The number of sheep in the county has stabilized in recent years due to a corresponding increase in small farm flocks.

A cooperative program for improving forage production through sagebrush control, new seedings of dryland grasses, and control of Medusa-head rye is being implemented. It is estimated that if these practices are implemented, the carrying capacity of rangeland could be increased by 17,100 cows and 15,400 calves. A corresponding increase in winter feed would be necessary to support this increased number of cattle.

In recent years, an outlet for fresh milk in Idaho has added some stability to milk production; however, this market may be temporary since the market could easily be absorbed by producers located closer to the Idaho consumers.



1/ *U..S..Census of Agriculture.*
2/ *Factors used to convert livestock into roughage animal units are: 1 cow = 1AU, 1 sheep =.2AU, 1 horse = .8AU.*

Figure 11

Agricultural Income

Value of sales of farm products for Baker County was about $10.8 million in 1964. Livestock products are the most important source of agricultural sales, accounting for 84 percent of the total (table 15). Beef cattle and sheep and wool products accounted for nearly $8.5 million or 78 percent of the total value of sales. Dairy and poultry products accounted for about 6 percent of the value of sales.

Table 15.--Value of farm sales, Baker County, Oregon, 1964 1/

Commodity	Value of sales
	Thousand dollars
All livestock and livestock products sold:	
Livestock and livestock products (other than poultry and dairy products	8,496
Dairy products	595
Poultry and poultry products	51
Total	9,142
All crops sold:	
Field crops (other than vegetables and fruits and nuts)	1,676
Vegetables	1
Fruits and nuts	6
Forest products and horticultural speciality products	13
Total	1,696
Total farm products sold	10,838

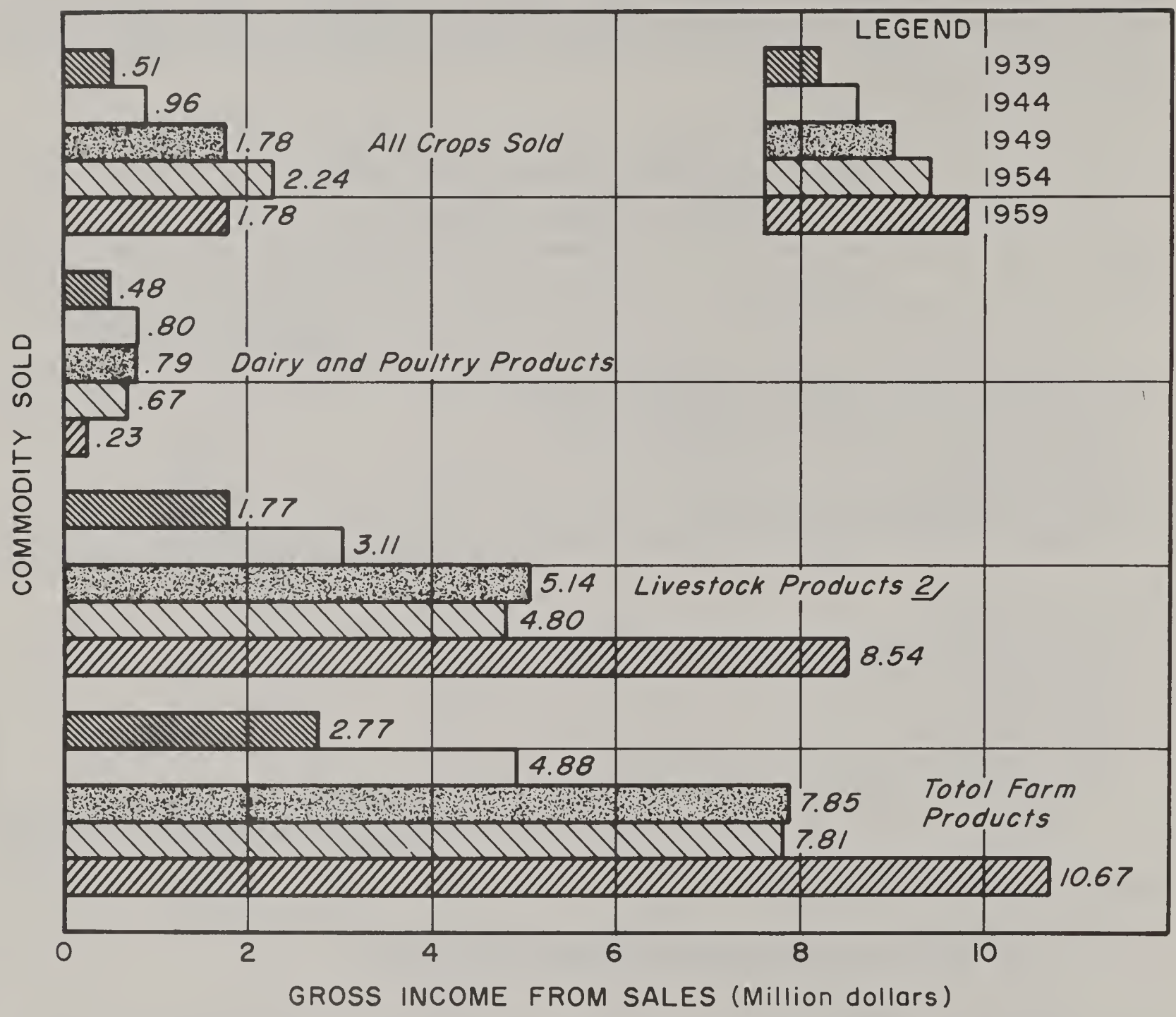
1/ U. S. Census of Agriculture: 1964, preliminary.

Since most of the hay and silage is fed locally and thus reflected in value of livestock, crops accounted for only about 16 percent of the total sales of farm products.

Income from the sale of livestock was lower than usual in 1964 due to low prices for cattle. Through the years, cattle and sheep have been the source of from 60 to 80 percent of the total agricultural income (figure 12).

Since the resources of the basin are geared to the production of beef cattle, the economic welfare of the farmers in the Powder Drainage Basin is largely dependent on prices for beef cattle. Dairy and poultry products accounted for 17 percent of the value of sales of farm products in 1939, but have decreased in importance and are now the source for only 6 percent of the value of sales. Income from the sale of crops has varied from 16 to 29 percent of the value of sales of farm products.

Gross income from sale of farm products by commodities,
Baker County, Oregon, 1939-59 1/



1/ *U. S. Census of Agriculture.*
2/ *Other than poultry and dairy products.*

Figure 12

Number and Size of Farms

There were about 757 farms in Baker County in 1959. Census data indicate that approximately 74 percent were commercial farms; 18 percent were part-time farms; and 8 percent were part-retirement farms. (Commercial farms are defined in the Census report as farms with a value of sales of $2,500 or more. Part-time farms are those with a value of sales of farm products of

$50 to $2,499 and operators under 65 years of age who either worked off the farm 100 days or more or had other income from nonfarm sources that was greater than the total value of farm products sold. Farms with a value of sales of farm products of $50 to $2,499 were classified as part-retirement if the farm operator were 65 years old or older.) In 1959, 27 percent of the farm operators worked off their farms 100 days or more and 30 percent of the farm families had income from other sources that exceeded the income from their farms. The median income to all farm families in Baker County in 1959 was $4,192 as compared to $4,824 for all farm families in the State of Oregon.

In 1959, the average farm in Baker County contained 1,170 acres and represented an investment of $55,699. In addition, most ranchers hold permits for grazing livestock on public lands. Ranches are rapidly increasing in size. While the number of farms has been decreasing since 1934, acreage per farm has more than doubled and investment in land and buildings per farm has increased by more than six times the 1934 level (table 16).

Table 16.--Number of farms, average acres per farm, and value of land and buildings per farm, Baker County, Oregon, 1929-59 1/

Year	Number of farms	Average size of farms	Value of land and buildings per farm
	Number	Acres	Dollars
1929	1,383	487	11,724
1934	1,383	529	8,255
1939	1,259	632	9,864
1944	1,088	796	13,018
1949	1,052	878	25,111
1954	998	964	32,575
1959	757	1,170	55,699

1/ U. S. Census of Agriculture.

Tenure

Most of the ranchers own all or part of the land in their farms. Census data indicate that in 1959, 62 percent of the farmers were full owners; 28 percent were part owners; 9 percent were tenants; and 1 percent were professional managers. During the past 20 years, there has been an increase in the percentage of part owners and a corresponding decrease in tenants.

Markets

Since there are no major population centers within the basin, most agricultural products are exported. The expansion of production of some crops and livestock products has been hindered by the lack of local markets. For instance, there are no large processing plants in the basin and the

specialized crops of potatoes, sugar beets, and peas that are raised must be shipped to areas outside the basin for processing. About 70 percent of the milk produced in Baker County is shipped by bulk tank trucks to the Idaho market. The lack of local marketing and processing plants is a definite disadvantage to producers of these products.

The markets for cattle and wool are well established. From 30,000 to 40,000 cattle are produced for sale annually and a marketing program has been developed for marketing the cattle. Cattle from throughout Baker County are assembled at a central location, sorted by size, type, and conformation, and sold at auction. About five auctions are held annually and 30 percent of the cattle are marketed through this program. This program is especially beneficial to the smaller ranchers since it permits them to offer uniform cattle in sufficient numbers to draw more buyers than if they sold individually.

Another marketing institution is the Baker-Union-Wallowa County Wool Pool. Wool growers contribute 1 cent per pound of wool to the organization for handling, grading, storing, and selling the wool.

Most of the grain produced in the basin is exported. About 95 percent of the wheat and 50 percent of the barley and oats is exported.

IRRIGATION

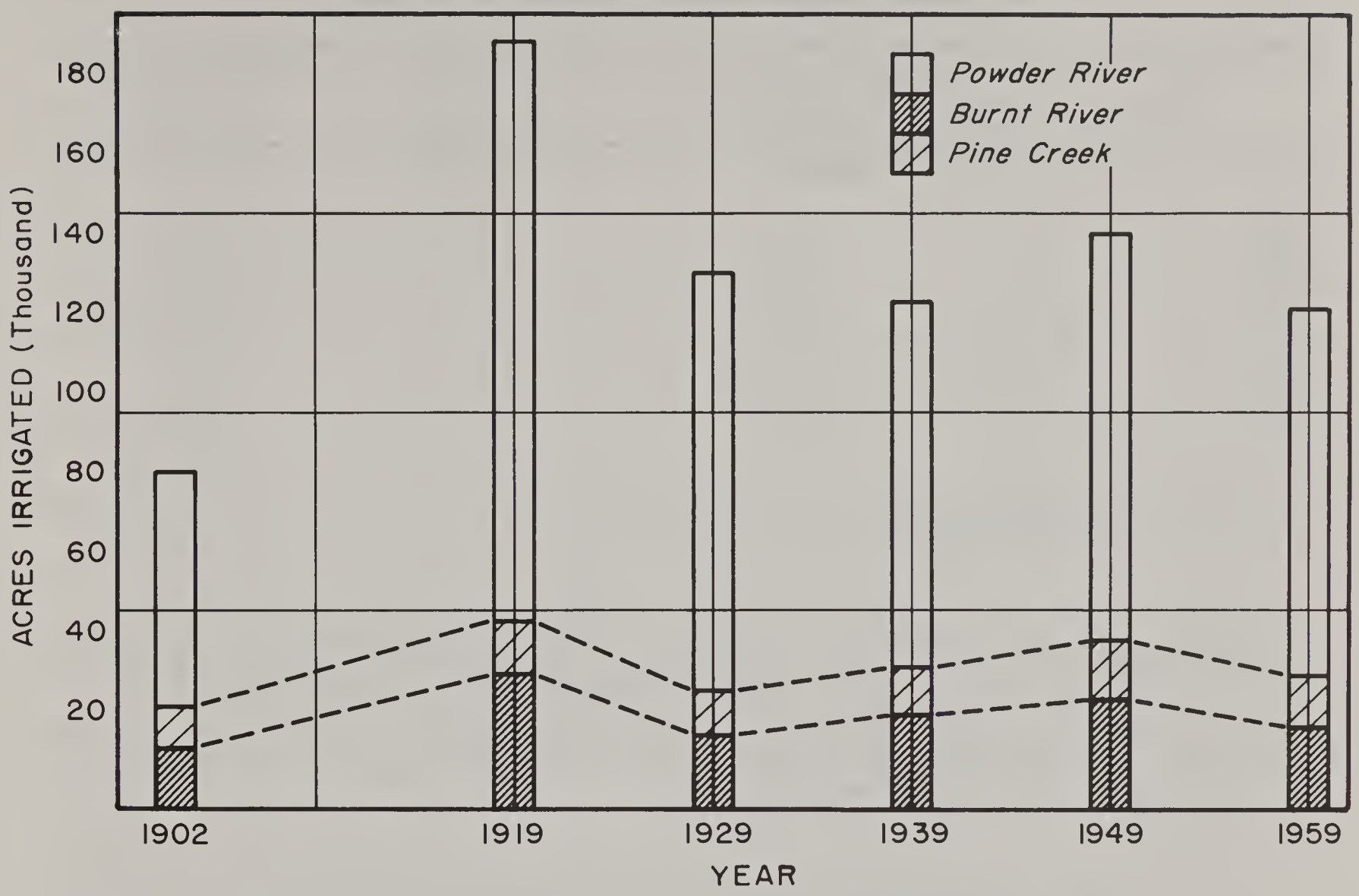
Past and Present Development

Irrigation began in the basin in the early 1870's with the diversion of water from streams to adjacent native pastures. The acreage under irrigation increased rapidly after 1900, and by 1919, 193,000 acres were irrigated. Water was over appropriated, and by 1929, the irrigated acreage decreased to 135,000 acres. Trends in irrigated acreage for the three major drainages in the basin--Powder, Burnt River, and Pine Creek--are shown in figure 13.

Acreage under irrigation has remained at an annual level of about 12,000 acres in the Pine Creek basin since 1902. Irrigated acreage did not increase significantly after the completion of Thief Valley Reservoir on the Powder River in 1931 or after the Unity Reservoir was completed on the Burnt River in 1938. Stored water was used to extend the irrigation period in both of these areas rather than to expand acreage under irrigation. Additional land was developed for irrigation but this was offset by the abandonment of irrigation on other land. Inadequate water supplies, high operation and maintenance requirements for canals, flumes, and diversions, and inadequate drainage are major reasons for abandonment of irrigation.

The number of farmers irrigating has gradually decreased during the past 25 years while the average acres irrigated per farm has gradually increased (table 17). These trends are associated with the general trend of fewer, larger, and more efficient farms. The percentage of farms irrigated, however, has not changed much since 1909.

About 643 farms in Baker County had irrigated land in 1964. The average acreage irrigated per farm was about 200 acres. Census data for 1959 indicate



1/ U..S..Census of Irrigation

Figure 13

that 30 percent of the farmers reporting irrigation had less than 50 acres under irrigation and nearly half irrigated more than 100 acres. Eight percent of the irrigators had 500 acres or more under irrigation (table 18).

The major irrigated crops, the extent to which they are irrigated, and crop yields were discussed in a preceding section of this report.

The acreage irrigated varies from year to year depending on water supplies. It is estimated that 169,300 acres in the basin are developed for irrigation but only about 135,000 acres were irrigated in 1964.

Natural streamflow is the source of water for 85 percent of the land developed for irrigation; reservoir storage is the source for 13 percent; and ground water is the source for only 2 percent (table 19). Gravity irrigation is still the usual method of applying water but the use of sprinklers is

Table 17.--Farms reporting irrigation and average acres irrigated, Baker County, Oregon, 1909-59 1/

Year	Farms reporting irrigation	Percentage of farms irrigating	Average acres irrigated per farm
	Number	Percent	Acres
1959	675	85	177
1954	868	87	147
1949	900	86	136
1944	904	83	135
1939	1,050	83	116
1929	1,113	80	107
1919	1,102	73	156
1909	1,051	81	123

1/ U. S. Census of Agriculture.

increasing. An estimated 7,700 acres are currently irrigated by sprinkler systems compared to less than 4,000 acres in 1959 and less than 300 in 1954. Sprinkler systems help conserve water supplies, eliminate the need for leveling land, and permit better control of water which helps reduce drainage problems. The disadvantages of sprinkler systems are higher costs and usually higher labor requirements.

Table 18.--Distribution of farms reporting irrigation by acreage intervals, Baker County, Oregon, 1959 1/

Irrigated acreage distribution	Number of farms reporting irrigation	Percentage distribution
	Number	Percent
1 to 9 acres	45	7
10 to 19 acres	46	7
20 to 29 acres	33	5
30 to 49 acres	76	11
50 to 99 acres	143	21
100 to 199 acres	154	23
200 to 499 acres	124	18
500 or more acres	54	8
	675	100

1/ U. S. Census of Agriculture.

Most of the irrigation development in the basin has been accomplished by small cooperative ditch companies or by farmers on an individual basis. There were 105 irrigation organizations in the Powder River drainage in 1950, 24 in the Burnt River drainage, and 42 in the Pine Creek drainage basin.

Table 19.--Water source and irrigation method,
Powder Drainage Basin, Oregon, 1965 1/

Item	Acreage developed for irrigation 2/
	Acres
Irrigation water source:	
Streamflow	144,600
Storage reservoir	22,000
Ground water	2,700
	169,300
Method of application:	
Sprinkler	7,700
Gravity	161,600
Total	169,300

1/ USDA River Basin Survey Staff data.
2/ Not all the acreage developed for irrigation would necessarily be irrigated in any one year.

The numbers of diversion structures maintained by these organizations were 518, 257, and 124, respectively. There are presently only two irrigation district organizations operating in the basin, the Burnt River Irrigation District with about 17,800 acres under irrigation and the Lower Powder River Irrigation District with about 7,000 acres. The assessment for the Burnt River District was $1.63 per acre irrigated in 1964. Data on costs of irrigation for the smaller cooperative ditch companies are not available. Most distribution systems consist of simple diversions and canals which have been built over a period of years by the owners, and annual costs are limited to maintenance and improvements. Records from the ASCS office indicate that land leveling in the basin has been accomplished at a rate of about 1,000 acres a year for the past 10 years.

Guidelines for Future Irrigation Development

Opportunities for additional irrigation development exist. There are about 268,700 acres of land capability classes I through IV in the basin (table 20). On the basis of soils alone, this is the land that is generally susceptible to irrigation. About 196,000 acres are presently being used as cropland or cropland pasture. An estimated additional 59,300 acres of land that is presently used as rangeland are suitable for cropland use. Thus, the upper limits for cropland in the basin are about 255,300 acres.

Estimates obtained from the USDA reconnaissance survey of the basin indicate that about 162,300 acres of cropland are developed for irrigation. It was also estimated that an additional 92,600 acres could be developed for irrigation if water were available. Thus, the maximum amount of cropland

Photo 19.--Gravity irrigation is the usual method of applying water in the basin. SCS

that could be irrigated in the basin is 254,900 acres. Much more study would be needed to determine if it is economically feasible to provide water and project development to irrigate this maximum figure.

Table 20.--Estimated present and potential cropland and irrigable land, Powder Drainage Basin, Oregon, 1965 1/

Item	Total basin
	Acres
Land capability classes I-IV	268,700
Total cropland	196,000
Potential cropland	59,300
Land developed for irrigation	169,300
Land irrigated, 1964	135,000
Potentially irrigable land	92,600

1/ USDA River Basin Survey Staff data.

Since irrigation water is already inadequate for the acreage developed for irrigation, any expansion of irrigation will require additional storage reservoirs or more efficient use of existing supplies. Several storage projects have been proposed and they will be discussed in another section of this report. In considering any of these proposed projects, several factors need to be borne in mind. First of all, livestock production has been and will probably continue to be the dominant agricultural endeavor in the basin. Livestock holds its competitive advantage largely because of the availability of low-cost forage from rangeland, irrigated pasture, and hayland. Although average yields from irrigated pasture and hayland have been low due to inadequate water supplies, irrigation costs have also been low. In most cases, irrigation costs have been limited to costs of constructing and maintaining diversion structures and canals. Usually the irrigation system has been constructed by the individual farmer which further reduced out-of-pocket costs.

There is no doubt that forage yields could be increased considerably through development of storage reservoirs; however, unless costs of irrigation are less than the value of increased production, farmers would not benefit from storage projects. The most efficient use of stored water is probably for firming up water supplies for land now developed for irrigation. Since diversion works and canals are already in place, yields could be increased substantially without adding to overhead costs for distributing and applying water.

Experience suggests that it would be a mistake to plan irrigation projects in the basin on the premise that there would be significant increases in high-value crops such as sugar beets, potatoes, and vegetables unless commitments were obtained for marketing the products. The fact that these crops can be grown in the basin does not insure that suitable market outlets will appear on the horizon. This area would have to compete with other areas that already have market outlets and processing facilities.

Finally, since irrigation is but one of many alternative investment opportunities, efficient allocation of resources will result only if returns from the investment are comparable with returns from other possible investments. Inputs such as fertilizer, improved pasture, drainage, and range improvement are some of the alternative investments. Opportunities for improving efficiency through combining irrigation distribution works and reallocating water to the more productive soils are other possibilities that should be investigated. Although changes such as these would involve modifying existing institutions, the resultant increase in efficiency may be judged worthy of such changes.

WATER RELATED PROBLEMS, NEEDS, AND OPPORTUNITIES

GENERAL

The method in which farm, forest, and range lands are managed has a direct influence on the yield and quality of water. Land use affects the suitability and availability of water for wildlife, recreation, and other uses. Land use and management practices can create or aggravate a host of water problems involving water excesses and quality. Correction of land use problems will usually reduce related water problems.

The water resource influences all segments of the economy of the basin. The use and development of this resource have a direct bearing on agricultural productivity. Industry and community existence is based upon a dependable supply of good quality water. Recreation, fish life, and pollution abatement are affected by volume and depth of flow; therefore, yield and seasonal availability of water are of prime importance in all areas of use.

WATER SUPPLY AND REQUIREMENTS

Average annual precipitation in the Powder Drainage Basin ranges from less than 10 inches to 80 inches (map 2). In the agricultural parts of the basin, rainfall averages less than 3 inches during June through September. Thus, the basin has a summer period of water shortage for agricultural uses as well as other uses. Streamflow originates mainly from snowmelt in the upper reaches of the watersheds. Natural streamflow is characterized by high runoff in the spring and low flow the remainder of the year; however, warm temperatures or rain storms occasionally produce high flows in the winter months. This combination results in waste of water and necessitates planned storage to improve efficiency and to provide for expansion in the use of water.

The total water resources of the basin are not adequate for maximum development of the agricultural needs. Total mean annual yield for this 2,073,700-acre basin is about 3,296,600 acre feet, while mean annual runoff or outflow is around 753,600 acre feet. The annual runoff ranges from less than 1 inch to nearly 40 inches. The data in table 21 were compiled for each watershed. These data were based on existing runoff records, the Weather Bureau isohyetal map (map 2), and correlation by the USDA.

The mean annual precipitation for the entire basin is about 19.1 inches, and the mean annual runoff is 4.3 inches. About one-third of the yield from precipitation is not consumptively used in the basin at the present time.

Water from wells and springs supplies the major part of the rural domestic water, a small portion of the livestock water, and a limited amount of the irrigation water. The quantity of water from wells is often not dependable for extensive irrigation.

In general, it can be concluded that there is not sufficient water within the basin for present and future needs.

Irrigation

The major irrigated crops in this basin are grass and legumes for hay and pasture (table 12). The average annual consumptive use for the crops is about 1.8 feet of water per acre. 1/ Precipitation provides about 0.4 foot, leaving 1.4 acre feet per acre to be supplied by irrigation. Much of the irrigation requirement in the basin is satisfied by multiple reuse of surface waste water. Using an average farm efficiency of 25 percent, losses in operation and transmission of 25 percent, and recovery of 50 percent of the waste water through multiple reuse, the average net diversion requirement is about 4.5 acre feet per acre.

At this rate, 730,400 acre feet are required to irrigate the 162,300 acres now in cropland or 97 percent of the estimated mean annual runoff. These figures indicate that storage of all available runoff would satisfy present irrigation needs. Only one watershed in the basin has an adequate water supply for the presently irrigated land under present practices (table 22).

It is estimated that an additional 92,600 acres could be readily irrigated for a total of 254,900 acres of irrigated land in the basin. This is an increase of 57 percent of the presently irrigated land. There are 268,700 acres in land capability classes I through IV, most of which is adaptable to irrigation in varying degrees (table 2). All watersheds but one have some land that has potential for irrigation development. Assuming present cropping patterns for water requirements, the minimum need for irrigation water would be approximately 1,147,000 acre feet. The full development of the basin's agricultural potential requires water storage reservoirs and imported water. The water needs are estimated at 165 percent of the mean annual runoff.

1/ The average annual consumptive use of 1.8 feet represents a cropping pattern of 50 percent alfalfa hay and 50 percent grass pasture. From Special Report 194 Agricultural Experiment Station, Oregon State University, Corvallis, Oregon. Consumptive use for hay is 24.3 inches and for pasture is 21.0 inches for a weighted consumptive use of 1.8 feet.

Table 21.--Average annual precipitation, yield, and runoff by watershed, Powder Drainage Basin, Oregon, 1965 1/

Watershed		Drainage area	Mean annual precipitation	Yield from precipitation	Mean annual runoff	
Number	Name	Acres	Inches	Acre feet	Inches	Acre feet
14-3	Oxbow	101,300	19.6	165,500	6.5	54,900
14-4	Pine Valley	128,400	27.1	290,000	11.1	118,800
14-5	Home	77,400	12.1	78,000	1.2	7,400
14-6	Benson Creek	15,900	12.1	16,000	1.1	1,500
14u-1	Eagle Valley	204,400	27.2	463,300	13.0	221,400
14u-2	Big Creek	155,300	22.9	296,300	3.1	40,100
14u-3	Lower Powder	145,800	12.9	156,700	0.4	4,900
14u-4	Wolf Creek	106,200	17.0	150,500	5.3	47,300
14u-5	North Powder	117,800	23.3	228,600	8.5	84,100
14u-6	Sumpter Valley	104,100	24.6	213,400	7.0	61,000
14u-7	Baker	220,700	15.8	290,600	0.4	7,400
14t-1	Durkee Valley	169,800	14.0	198,100	1.4	19,800
14t-2	Lower Burnt	119,200	13.2	131,100	1.2	11,900
14t-3	Middle Burnt	127,100	17.0	180,000	1.9	20,100
14t-4	Whitney	103,100	20.1	172,700	2.9	24,900
14t-5	Unity	177,200	18.0	265,800	1.9	28,100
Total		2,073,700	19.1	3,296,600	4.3	753,600

1/ USGS Records and USDA Soil Conservation Service correlations.

Table 22.--Summary of small watersheds with inadequate irrigation water supply, Powder Drainage Basin, Oregon, 1965 1/

Item	Unit	Basin total
Watersheds studied	Number	16
Watersheds with water shortages for presently irrigated land	Number	15
Presently irrigated land with water shortages	Acres	130,900
Watersheds with inadequate water for potentially irrigable land	Number	13
Potentially irrigable land needing surface water development	Acres	88,300

1/ USDA River Basin Survey Staff data.

Livestock

Water for livestock is normally adequate during the spring; however, stock water developments are needed throughout the range area to improve the utilization of rangeland and the distribution of livestock during the summer

and fall grazing season.

Since grazing is only one of the important uses of land in the basin, it has to be considered in relation to forest, watershed, wildlife, recreation, and mining. Such problems as forest and range management concern the private landowner as well as the managers of public lands. It is particularly important that water be kept on land and absorbed to minimize runoff and damage from erosion. This means that there must be careful use of forage cover to maintain its value for watershed purposes.

Forestry and Related Uses

Water supply problems on forest land are few. Natural streamflows are generally adequate to meet all consumptive requirements. Some pollution and siltation problems have developed in the basin when thoughtless or careless timber harvesting and mining have occurred and when forest fires have burned over whole watersheds. This problem is not so great now. Measures are taken to rehabilitate large burned areas as fast as practicable.

Photo 20.--Stock water developments help improve range utilization and livestock distribution. SCS

Water supply problems are expected to become greater as use of forest land is intensified and as the demand for water for agriculture and industry

is increased. Prevention of stream pollution will require continual attention with increased recreational use and access to all parts of most watersheds.

There will be increasing concern in maintaining adequate streamflows and lake levels for fish, wildlife, and recreation. Additional needs for larger water supplies for irrigation and industry will have to be met by greater reservoir storage of water from forested watersheds. If reservoirs are drawn down to very low levels during the season of heavy recreational use, the water becomes less attractive for recreation, pollution problems increase, and fish life may be endangered. Natural lake levels and streamflows will also be lowered by increased water consumption.

WATERSHED MANAGEMENT PROBLEMS AND OPPORTUNITIES

Maintenance and improvement of the condition of all tributary watersheds in the basin should be continued. Overall, the optimum watershed conditions will prevail when all resources are managed for sustained production. The most important management problems and opportunities for improvement pertaining to agriculture, range, and forestry are outlined in the following sections.

Agricultural Land

The agricultural land is one of the most important resources of this basin. The maximum use of this important resource will require additional development and intensification of use. To accomplish this, improved management and control of the water resource are needed. The productivity of many native and marginal pasture and hay fields could be increased by planting better adapted species of grasses and legumes. The native grass fields not suited for cultivation should be replanted to range species and managed for this primary use. A summary of the water related problems and the measures needed to improve them follows.

Flooding. Flood problems in the Powder Drainage Basin are a result of both natural factors and human management of the land. Modern man, through his intensive use of the land and other natural resources, has greatly intensified flooding problems in some areas, while in other areas, he has protected the land and used it for agricultural and urban development.

The main cause of floodwaters in this basin is spring snowmelt, but floods occasionally result from other causes such as rainfall alone, rainfall augmented by snowmelt, and thunderstorms. Floods are most likely to occur in March through June and to originate principally from snowmelt, but on occasion, early spring rains or snowmelt along with frozen ground conditions produce extreme flows from lower elevation tributaries. Agricultural land along the main rivers and tributary streams is subject to overflow during high flows. Photo 21 illustrates the type of damage that occurs to farmland along the streams.

Damage would be more widespread and severe if the land were in crops other than pasture and hay. Torrential rainstorms occur occasionally in the spring and summer causing severe soil erosion and flood damage (photo 22).

Photo 21.--Flooding on Clear Creek has caused this debris deposition and damage to the roads and fences. SCS

Photo 22.--A cloudburst caused the Burnt River near Bridgeport to overflow its banks resulting in erosion and flood damage.

Approximately 11,400 acres of land are flooded to varying degrees. Of this acreage, 80 percent is cropland and the remaining 20 percent is low-lying forest and range lands. Much of this land is along the lower reaches of the streams where the channel gradients are flat and the banks are not well defined. When the heavy runoff reaches these areas, the water overflows the channels, floods many of the fields, and deposits its sediment and debris.

The agricultural problems resulting from floods include erosion and sedimentation and losses of crops and property. Agricultural damages consisting primarily of crop and property losses account for much of the total evaluated flood damage. Crop damage is minimized because most of the land is in sod-forming crops. The spring and summer floods cause some damage to crops by depositing silt on them and by washing out roots, seeds, and seedlings.

Manmade structures and improvements are often damaged by flooding. Some towns and farmsteads have suffered from flood damage. Many country roads and some highways are damaged by undercutting, sedimentation, and destruction of bridges and culverts. Municipal and domestic water supplies, diversion works, and canals are often damaged by high water and sediment.

It is extremely costly to remove sand, gravel, logs, and other debris deposited by major floods in channels, fields, ditches, and other improvements (photo 23).

Photo 23.--Flood flows on Pine Creek have deposited bed load and debris which should be removed. SCS

More stream-channel improvement and storage capacity in reservoirs are needed to reduce flood damages.

Erosion. Damage to land from erosion, scour, and deposition is significant but very difficult to evaluate and is probably inadequately appraised.

Most of the arable land is effectively protected from rill and sheet erosion by perennial, sod-forming crops; however, when such a crop is plowed for re-establishment or replacement by annual crops, care should be taken to insure that the soil is protected against erosion. Estimates indicate that about 190,000 acres of arable or potentially arable land (land capability classes I-IV, table 2) are subject to erosion problems. Precautions should be taken in the management of this land to protect it from erosion.

Erosion presents a serious problem on both rangeland and cropland. On rangeland, the problem covers a widespread area due to steeper land and overgrazing. On cropland, the problem is quite costly due to the loss of valuable land and the damage to crops. Considerable erosion damage is a result of poor irrigation water management as well as poorly planned irrigation facilities. Erosion causes undermining of diversion dams and other structures such as headworks. This problem needs to be handled in conjunction with the reorganization of irrigation systems as a group project rather than by individual landowners.

Considerable land is lost through streambank erosion. Damage is usually most prevalent in the swifter portions of the streams, but larger, slower portions have also contributed to the problem. There is need to protect banks with rock and vegetation and to remove gravel bars, drift, and brush in places where they are restricting flow and directing currents toward the bank (photo 25).

Stream channel work is usually most beneficial when a complete unit of channel is improved in a single coordinated project rather than by piecemeal work by individual landowners.

Irrigation. Irrigation is a major consumptive use of water in the Powder Drainage Basin. It has been developed by both individual and group efforts; however, future development will probably require more group action.

Water is applied by both gravity and sprinkler systems. The gravity systems are being used much more extensively than sprinkler systems; however, the use of sprinkler systems is increasing rapidly. To obtain the maximum benefits from irrigation and the least damage from erosion, the amount and frequency of water application should be adapted to the soil, the crops, and the weather. The technical advisor and the farmer need more factual information on water-holding capacities and intake rates of soils to facilitate more efficient use of water and to protect the land from erosion.

There are about 900 diversions transporting irrigation water within the basin. Many of these are several miles long and built in stony to very stony, medium- to fine-textured soils. This situation creates substantial water losses which often result in land damage by creating wet croplands that require drainage. To reduce water losses, soil erosion, maintenance and

Photo 24.--Runoff from poor condition rangeland created this gully and deposit of sediment near Durkee. SCS

Photo 25.--Channel clearance and bank protection are needed to reduce cutting and loss of valuable agricultural land in Eagle Valley. SCS

Photo 26.--This is a typical diversion for irrigation water in the Powder Drainage Basin.

management expenses, some of these distribution systems of canals and ditches have been reorganized and combined. Many more need to do this through group action.

Drainage. Approximately 33,600 acres, or about 13 percent of the arable soils, have a major wetness problem (table 23). These figures are based upon soil surveys and the Oregon Soil and Water Conservation Needs Inventory 2/.

Wet soils either have been drained to a degree necessary for the crop being grown or are used for purposes that do not require drainage. An estimated 28,500 acres, or about four-fifths of the excessively wet soils, need to be drained for best production under present use. About two-thirds of this land could be drained with open drains (photo 27) while the remaining area needs tile drains (photo 28). In some cases, improved outlets could reduce the drainage problem. Besides stabilizing production through water table control, drainage of this land would also increase, to some degree, the number and variety of crops that could be grown. In some cases, stored drainage water could be used for irrigation.

In this basin, the elimination of prolonged flooding is often a prerequisite to successful drainage. In most cases, this can be classified as

2/ The Oregon Conservation Needs Committee, Portland, Oregon, September 1962.

Photo 27.--This drainage ditch, under construction in the Baker Valley, will drain 30 acres that have been too wet for pasture or hay. SCS

Photo 28.--This closed tile drain is under construction in the Baker Valley. SCS

Table 23.--Estimated acreage of soils within land capability classes I-IV whose major problem is wetness and the total acreage needing drainage, Powder Drainage Basin, Oregon, 1965 1/

Land capability class	Unit	Basin total
I	Acres	0
II	do.	17,900
III	do.	15,200
IV	do.	500
Total	do.	33,600
Area needing drainage	do.	28,500

1/ USDA River Basin Survey Staff, Soil Conservation Service, and Forest Service.

flood control; however, surface water disposal is required in some instances where the land is nearly level. This land is usually in the broad, flat valleys where the channel gradient is fairly flat.

Seepage waters from high land are also a common cause of drainage problems. Frequently this can be eliminated by using open or closed interceptor drains; however, random- or pattern-type systems are also necessary to drain many areas. Tile, wood box, and various kinds of suitable pipe are used for the closed systems.

Mining. There are several areas in this basin where damages from mining deposits are a serious problem. Hydraulic mining in the Salmon Creek area near Baker and along the Burnt River and other areas has left deep scars and watershed damage. Mine tailings in the Sumpter Valley have ruined many acres of land that could have been put to more beneficial uses. These areas and other similar areas on a smaller scale contribute to erosion and water pollution problems.

Forest and Range Lands

Careful management of forest and range resources can result in maximum economic and social benefits without impairment of soil and watershed values; however, improper management of these resources can produce or intensify flood, erosion, and sedimentation problems. Forest and range lands are generally on steep ground where the hazard from water erosion is greatest. Erosion by rapid runoff of water may be very damaging if protecting vegetation is removed from large areas.

Protection of forest and range watersheds from wildfire has improved in recent years with the initiation of new techniques of detection and control. Aerial patrols for detection, retardant bombers, smokejumpers, improved weather forecasting and reporting, and better communications are a few of the improvements.

Lightning and man are the two major causes of fire within the basin. Detection and control procedures for the lightning hazard under normal conditions are adequate. Continued effort by all fire control agencies in the basin to inform the public of the of the hazards and losses of fire is needed.

Improvement in the condition of watersheds in the basin is needed. On public land, desirable watershed management is a matter of public policy which should be strengthened and extended to all phases of forest and range resource management. On private land, good watershed management provides few visible benefits to the individual landowner since he uses little of the water that flows from his land, and any reduction in soil fertility due to poor watershed management may not be apparent for a long time; however, good watershed management on all forest and range lands is vital to water users and to landowners in downstream areas. Recently, public pressure and enforcement of antipollution laws have caused some improvement in watershed management on private land. There is need for much additional improvement. Some factors that would produce better management are:

1. Greater monetary returns from tree farming would encourage landowners to keep their land in a productive condition and help provide for soil protection. Roads constructed and maintained in a good condition would be less subject to erosion.
2. Strengthening the services to landowners by the Extension Service, Soil Conservation Service, and State Farm Forester and informing the general public of the value of water and the importance of good watershed management might produce better management practices.
3. Increased public pressure from recreationists, fishermen, and other water users would cause many private owners to give greater consideration to good watershed management practices.
4. Enactment and enforcement of stricter regulations controlling land management practices that produce stream siltation, debris jams, and flood hazards may be necessary if forest and range landowners fail to meet their watershed management responsibilities. Regulation has often been necessary to control other sources of water pollution such as sewage and wastes from manufacturing processes.

Forest land managers need additional knowledge about many phases of forestry to enable them to do a better job of watershed management. One of the most important needs is for more detailed information about soils and geology to identify areas with serious surface erosion, slump, and slide hazards. Increased detailed hydrological data for forested watersheds are also needed for better planning of drainage structures on access roads. Timber harvesting methods that minimize watershed damage need to be encouraged.

Inadequate access is a problem in some areas. Some of the reasons for this are problems encountered in obtaining rights-of-way, problems of construction, and problems in adequate financing. Many of the other problems associated with land management could be reduced if the area were readily accessible.

Photo 29.--Extreme erosion was occurring on the Anthony Lake fire area before revegetation, August 1960.

Photo 30.--Seeded grasses protect the same area the following summer (1961).

At the same time, it is very important that the roads be properly designed and constructed. Poorly planned and constructed roads are major sources of erosion. Slash resulting from logging or road rights-of-way clearing may accumulate in streams, block fish passage, and pose a threat of flash floods during severe storms.

Photo 31.--Using a waterway for a downhill skid trail causes many problems. SCS

Approximately half of the rangeland watersheds are in poor condition with deficient vegetative cover and considerable accelerated erosion. Rehabilitation of the rangeland is essential to realize maximum benefits from the land and to minimize downstream flood and sediment damage. Some programs and practices that should be initiated or continued are:

1. Large-scale land treatment programs including erosion control measures, removal of brush species which occupy the site but furnish little forage for soil protection, and revegetation with soil-protecting, drought-resistant grasses.
2. Reseeding and water spreading to provide additional forage on the better rangeland.
3. Control of timing and intensity of livestock grazing through (a) development of additional supplies for water for consumption by livestock; (b) construction of fences to control livestock movement; (c) salt distribution and herding of livestock to obtain more uniform use of forage.
4. Rapid control of forest and range fires and prompt revegetation

Photo 32.--Too much of the rangeland is in condition similar to this with sparse vegetation and accelerated erosion. SCS

of burned areas to protect the forage crop and watershed cover.

5. Study need for additional winter range for big game and maintain big game numbers in balance with available winter range.

Rangeland areas of steep topography, naturally sparse vegetation, or extremely erodible soils should be left in a relatively undisturbed condition. Grazing should never deplete the ground cover to a point where protection of the watershed and maintenance of desirable vegetation are impaired.

In addition to the specific items mentioned in reference to forest and range management, the land manager must recognize his responsibility for management of all resources. Practices that can help enhance watershed values without diminishing the value of forest and range for other uses have been stated previously. The public land manager, particularly if trained in forest or range management, can exert an important influence in encouraging good watershed management practices. He plays an important role in determining the management of public and private land; thus, he has an opportunity and the responsibility to sell multiple-use management of all watershed resources.

WATER DEVELOPMENT

The limited water in this basin should be developed to serve all phases of the economy. Because there is not sufficient water yield to supply all possible future needs, water development plans should be comprehensive with due consideration given to the use of Snake River water whenever possible. A major purpose of future water development projects in the basin will be for the development of adequate water for agriculture. For instance, an estimated 92,600 acres of additional land could be irrigated if sufficient water were available. In addition, about 80 percent of the 162,300 acres of land presently developed for irrigation is short of late season water. Better utilization of existing supplies and careful development of all sources, including water from outside the basin, would be necessary to meet this demand. However, most future water development projects will need to include other phases of water use and control such as flood control, power, domestic, municipal, industrial, fish, wildlife, recreation, and pollution abatement which are sometimes compatible with irrigation but may more often be competitive. The demand for all uses will probably increase in the future.

Since the delineation of water resource needs for agriculture is a major purpose of this report, agricultural water uses are emphasized in the following sections pertaining to ground water, surface water, and water storage.

Ground Water

Ground water is not presently used heavily for agriculture. It irrigates only about 2,700 acres, or less than two percent of irrigated acreage in the basin (table 24) and is being used principally for domestic and livestock purposes. Studies indicate that ground water in this basin could be developed to a much greater extent, but the maximum irrigable acreage that could be supplied by ground water probably would not exceed 7,000 acres.

Additional wells are needed for stockwater in the basin. The potential of ground water development from springs for this purpose has not been fully utilized in some areas. The rate of yield from springs is usually too limited to meet irrigation requirements.

Drainage water from wet soils can sometimes be used for irrigation by developing shallow wells or sumps. The rate of yield can often be increased by collecting the water with a drainage system of tile and ditches. Supplemental water supplies can be developed in a few irrigated areas through planning drainage systems to utilize this source of water.

Surface Water

There is very little excess, naturally flowing surface water in the basin during the middle and late summer months; however, if ground water aquifers were artificially recharged in the winter, natural flows in some streams would probably increase. A few streams have late spring and early summer water that could have limited development. Surface water availability will be discussed in each watershed in the next section of the report.

Storage

The opportunity for conservation of excessive, often damaging, runoff water in reservoirs for flood protection and subsequent use for irrigation, stockwater, industry, domestic, recreation, pollution abatement, and fish life has considerable potential in the Powder Drainage Basin.

A summary of estimates from various parts of the basin has indicated that it will be necessary to construct both large and small reservoirs and to use water from outside the basin to achieve maximum irrigation development (table 25). This storage could be developed when and where it is needed. There is a definite potential for more farm ponds and small reservoirs. In addition, there are several medium-sized reservoir sites of 100 to 25,000 acre-foot storage capacity that should be considered for water development for individual and group needs. Table 25 summarizes reconnaissance data assembled by the Department of Agriculture on 37 sites that appear to have some merit and warrant future consideration. Various agencies conducted the investigation of these sites. The location of these sites is shown on map 8.

Photo 33.--The Wallowa Mountain Range provides the background for this typical stockwater pond. SCS

The Brownlee Reservoir on the Snake River is a potential source of irrigation water from outside the basin. The Bureau of Reclamation is constructing the Mason Dam, a large, multipurpose reservoir, on the Powder River. They are also investigating two medium-sized sites for multipurpose use.

WATERSHEDS

14-3	Oxbow
14-4	Pine Valley
14-5	Home
14-6	Benson Creek
14u-1	Eagle Valley
14u-2	Big Creek
14u-3	Lower Powder
14u-4	Walf Creek
14u-5	North Powder
14u-6	Sumpter Valley
14u-7	Baker
14t-1	Durkee Valley
14t-2	Lower Burnt
14t-3	Middle Burnt
14t-4	Whitney
14t-5	Unity

LEGEND

- Possible Reservoir Sites
- Watershed Boundary
- River Basin Boundary
- National Forest Boundary

WATERSHED CLASSIFICATION

- Best P.L. 566 Possibilities
- Application Approved P.L. 566
- Others Studied

DRAINAGE BASIN LOCATION

COUNTY LOCATION

MAP 8

INDEX MAP OF WATERSHED AREAS AND POSSIBLE RESERVOIR SITES POWDER DRAINAGE BASIN OREGON

JANUARY 1966

SCALE IN MILES

U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE USDA SCS PORTLAND OREG 1967

M 7-E-17866-N

These are the Dark Canyon site on the Burnt River and the Hardman site on the South Fork Burnt River.

All new reservoirs should be developed for multipurpose use, considering all possible uses and benefits from the stored water.

Table 24.--Reconnaissance data on small watersheds, Powder Drainage Basin, Oregon, 1965 1/

Item	Unit	Watershed																Totals
		14-3	14-4	14-5	14-6	14u-1	14u-2	14u-3	14u-4	14u-5	14u-6	14u-7	14t-1	14t-2	14t-3	14t-4	14t-5	
		Oxbow	Pine Valley	Home	Benson Creek	Eagle Valley	Big Creek	Lower Powder	Wolf Creek	North Powder	Sumpter Valley	Baker	Durkee Valley	Lower Burnt	Middle Burnt	Whitney	Unity	
Farms	Number	2	118	4	2	80	50	35	115	175	7	205	25	15	15	5	20	873
Watershed area	Acres	101,300	128,400	77,400	15,900	204,400	155,300	145,800	106,200	117,800	104,100	220,700	169,800	119,200	127,100	103,100	177,200	2,073,700
GENERAL LAND USE:																		
Forest land	Acres	46,800	55,600	4,000	0	94,400	54,700	0	38,200	54,200	85,000	66,600	11,500	5,600	55,000	84,500	105,600	761,700
Grazed	do.	46,800	55,600	4,000	0	94,400	54,700	0	13,000	16,000	51,000	55,700	11,500	5,600	55,000	68,500	75,600	607,400
Nongrazed	do.	0	0	0	0	0	0	0	25,200	38,200	34,000	10,900	0	0	0	16,000	30,000	154,300
Cropland	Acres	100	17,100	600	400	10,400	11,800	17,700	19,200	37,500	3,000	52,400	5,000	3,600	4,900	3,900	8,400	196,000
Nonirrigated	do.	0	0	300	100	2,100	5,100	5,600	7,000	5,200	100	4,200	1,300	1,800	100	500	300	33,700
Irrigated 2/	do.	100	17,100	300	300	8,300	6,700	12,100	12,200	32,300	2,900	48,200	3,700	1,800	4,800	3,400	8,100	162,300
Rangeland	Acres	48,700	46,900	70,800	15,300	84,100	80,900	124,100	46,000	18,100	4,700	79,100	149,100	107,700	61,300	10,000	59,400	1,006,200
Nonirrigated	do.	48,700	44,900	70,800	15,300	82,100	80,900	124,100	45,000	18,100	4,700	77,100	149,100	107,700	61,300	10,000	59,400	999,200
Irrigated	do.	0	2,000	0	0	2,000	0	0	1,000	0	0	2,000	0	0	0	0	0	7,000
Other	Acres	5,700	8,800	2,000	200	15,500	7,900	4,000	2,800	8,000	11,400	22,600	4,200	2,300	5,900	4,700	3,800	109,800
IRRIGATION:																		
Water source:																		
Streamflow	Acres	100	18,900	300	100	10,300	5,900	3,100	12,400	31,800	2,900	48,000	1,800	1,300	400	2,800	4,500	144,600
Reservoir storage	do.	0	0	0	200	0	800	8,400	500	100	0	1,000	1,900	500	4,400	600	3,600	22,000
Ground water	do.	0	200	0	0	0	0	600	300	400	0	1,200	0	0	0	0	0	2,700
Method of application:																		
Sprinkler	Acres	0	300	100	200	0	400	700	1,000	1,000	100	3,200	100	100	100	100	300	7,700
Gravity	do.	100	18,800	200	100	10,300	6,300	11,400	12,200	31,300	2,800	47,000	3,600	1,700	4,700	3,300	7,800	161,600
Water rights	Acres	1,230	18,410	160	890	19,380	7,720	18,880	16,450	34,510	6,370	51,740	5,930	2,330	6,100	3,770	9,930	203,800
Water shortage	Acres	0	12,000	200	100	6,000	4,600	2,000	12,400	31,900	2,900	48,000	1,900	1,300	300	1,600	5,700	130,900
POTENTIAL:																		
Cropland	Acres	0	2,000	2,200	4,000	900	2,300	1,300	0	0	2,500	28,000	5,000	2,000	2,900	3,000	3,200	59,300
Irrigable land	Acres	0	2,000	2,500	4,100	3,000	7,400	6,500	7,000	5,200	2,600	32,200	6,300	3,800	3,000	3,500	3,500	92,600
Available water 3/	Ac. ft.	54,900	118,800	7,400	1,500	221,400	40,100	4,900	47,300	84,100	61,000	7,400	19,800	11,900	20,100	24,900	28,100	753,600
Water source:																		
Streamflow	Acres	0	0	100	0	0	1,800	0	1,000	2,000	0	0	300	100	200	0	0	5,500
Reservoir storage	do.	0	2,000	2,400	4,100	3,000	5,600	6,500	6,000	3,200	2,600	29,700	4,300	3,600	2,800	3,500	3,500	82,800
Ground water	do.	0	0	0	0	0	0	0	0	0	0	2,500	1,700	100	0	0	0	4,300
DRAINAGE:																		
Arable land needing drainage	Acres	0	2,500	0	0	1,500	400	1,600	1,100	2,300	600	14,000	400	0	2,000	300	1,800	28,500
FLOODING:																		
Area	Acres	0	800	40	50	60	350	1,850	200	200	600	4,000	200	50	500	150	2,350	11,400
STORAGE:																		
Ponds (existing)	Number	0	50	0	0	9	19	53	0	0	10	25	3	50	0	5	0	224
Reservoirs (existing)	Number	0	9	1	1	9	13	3	2	3	0	7	3	3	0	0	10	64
Reservoir sites studied	Number	0	4	0	0	2	6	0	4	5	1	1	4	0	1	7	2	37

1/ Based on data collected by the USDA River Basin Survey Staff. Estimates provided by local personnel of the Soil Conservation Service, Forest Service, ASCS, BLM, and County Extension Service.
2/ Land developed for irrigation.
3/ Mean annual runoff.

Table 25.--Reconnaissance data on some reservoir sites, Powder Drainage Basin, Oregon, 1965 1/

Stream	Watershed index	Reservoir index	Location			Drainage area	Estimated annual yield	Storage capacity	Reservoir water depth	Reservoir surface area	Top length of embankment	Estimated embankment volume	Fill ÷ storage	Possibilities	Source
			Township	Range	Section										
Name	Number	Number				Acres	Ac. ft.	Ac. ft.	Feet	Acres	Feet	Cu. yds.	Cy/ac. ft. 2/	Uses 3/	Number 4/
Jimmy Creek	14u-4	1	5S	39E	35	25,200	7,100	3,600	68	160	420	100,000	28	I,F,R	1
Sunnyslope Reservoir	14u-4	2	6S	39E	10	320	...	455	40	50	610	30,500	67	I	1
Wolf Creek	14u-4	3	6S	38E	11	21,100	15,100	12,650	125	230	1,600	969,000	67	I,F,R	1
Pilcher Creek	14u-4	4	6S	38E	22	3,500	1,500	5,500	95	160	1,350	533,900	97	I	1
North Powder River	14u-5	5	7S	38E	5	28,800	34,900	19,500	200	260	1,000	2,000,000	100	I,F,R	1
Dutch Flat Creek	14u-5	6	7S	37E	20	1,250	2,000	2,000	50	68	900	110,000	55	I,R	1
Muddy Creek	14u-5	7	7S	39E	21	12,700	4,900	1,000	35	100	1,700	90,000	90	I,F,R	1
Rock Creek	14u-5	8	8S	38E	7	9,300	13,400	3,500	85	90	1,000	400,000	114	I,R,S	1
Rock Creek	14u-5	9	8S	38E	18	8,200	12,200	4,000	95	100	1,000	375,000	94	I,R,S	1
Powder River (Mason Site)	14u-6	10	10S	38E	24 & 25	112,000	65,500	100,000	...	2,450	920	1,000,000	10	I,F,R	2
Blue Canyon	14u-7	11	10S	39E	24	5,850	5,400	2,900	60	133	450	121,000	42	I,F,R	1
Beagle Creek	14u-2	12	6S	41E	14	6,850	8,600	12,200	107	415	840	419,400	34	I,F,R	1
West Eagle Creek	14u-2	13	6S	43E	5	6,300	18,900	1,800	44	90	375	53,900	30	I,F,R	1
Goose Creek	14u-2	14	7S	43E	10	5,100	12,700	2,550	85	75	700	375,000	147	I,F,R	1
Goose Creek	14u-2	15	7S	43E	14	6,800	17,000	6,000	140	65	435	562,000	94	I,F,R	1
Sawmill Creek	14u-2	16	8S	43E	12	4,100	7,500	7,500	103	250	1,150	355,500	47	I,F,R	1
Goose Creek	14u-2	17	8S	43E	8	39,500	82,300	1,300	91	36	440	252,480	194	I,F,R	1
Empire Gulch	14u-1	18	7S	44E	20	...	...	2,500	85	97	1,200	225,000	90	I,R	1
Summit Creek	14u-1	19	7S	45E	28	1,800	6,000	700	65	27	600	...		I,R	1
Meadow Creek	14-4	20	6S	45E	35	700	2,100	690	40	45	450	63,100	91	I,R	1
East Pine Creek	14-4	21	7S	46E	20	12,000	18,600	6,000	120	140	560	440,000	73	I,F,R	1
Deer Creek	14-4	22	8S	47E	29	7,500	9,400	2,210	80	69	500	222,900	101	I,F,R	1
Sag Site	14-4	23	9S	46E	3	...	...	1,500	60	80	700	160,000	107	I,R	1
Lawrence Creek	14t-1	24	10S	43E	29 & 32	...	...	18,000	...	...	...	...	...	I,F,R	2
Lawrence Creek	14t-1	25	10S	43E	31	...	...	21,000	...	...	...	...	...	I,F,R	2
Alder Creek	14t-1	26	10S	41E	35	3,300	4,400	270	50	14	270	40,000	148	I,R	1
Alder Creek	14t-1	27	11S	41E	1 & 2	1,900	2,700	490	50	26	550	98,600	201	I,R	1
Burnt River (Dark Canyon Site)	14t-3	28	12S	41E	10	407,400	75,000	10,700	96	...	215	...	...	I,F,R	2
North Fork Burnt River	14t-4	29	11S	36E	14	...	25,400	6,600	70	...	400	...	...	I,F,R	2
North Fork Burnt River	14t-4	30	11S	36E	14	...	...	...	...	...	...	...	...	I,F,R	2
North Fork Burnt River	14t-4	31	11S	36E	3	...	...	20,000	...	...	...	...	...	I,F,R	2
Trout Creek	14t-4	32	11S	36E	2	18,800	31,300	3,500	50	184	...	67,400	19	I,R	1
Trout Creek	14t-4	33	10S	36E	35	13,500	22,500	300	30	...	350	...	...	I,R	1
North Fork Burnt River	14t-4	34	10S	35½E	25	18,600	38,700	2,000	40	...	...	...	...	I,R	1
Tributary North Fork Burnt River	14t-4	35	10S	35E	36	1,000	2,200	2,000	...	120	...	...	...	I,R	1
Pole Gulch	14t-5	36	13S	36E	12	6,200	5,700	...	...	...	...	...	...	I,R	1
South Fork Burnt River	14t-5	37	13S	36E	22	28,400	25,500	11,000	78	...	520	...	...	I,F,R	2

1/ Based on a survey by the U. S. Department of Agriculture River Basin Survey Staff.
2/ A comparative figure derived from dividing the estimated earth fill in cubic yards by the estimated water storage capacity in acre feet.
3/ I - irrigation, F - flood protection, R - recreation--fishing, hunting, and boating, S - water supply--industrial, municipal, and domestic.
4/ Source: 1 - Soil Conservation Service, 2 - Bureau of Reclamation.

OPPORTUNITIES FOR WATERSHED PROTECTION AND FLOOD PREVENTION PROJECTS

DESCRIPTION OF PUBLIC LAW 566

The Watershed Protection and Flood Prevention Act, Public Law 566, as amended, authorizes the Secretary of Agriculture to cooperate with local organizations in planning and carrying out works of improvements for flood prevention and/or for the conservation, development, utilization, and disposal of water in watershed or sub-watershed areas smaller than 250,000 acres. The Act provides for technical, financial, and credit assistance by the U. S. Department of Agriculture to landowners, operators, and other people living in small watersheds. Project-type action under the Act is intended to supplement other soil and water conservation programs and other programs for the development and flood protection of major river valleys.

WATERSHED SURVEY

The USDA River Basin Survey Staff made a survey of the potential for P. L. 566 work in the Powder Drainage Basin to provide information as a guide to long-range coordination and planning of future projects. The basin was divided into 16 tributary watershed areas which are designated by number and are delineated on map 8. A preliminary survey was made of each watershed to gather basic reconnaissance data on land and water use and water-related problems which are summarized in table 24.

Information in this table is based upon estimates by local personnel of the Soil Conservation Service, the County Extension Service, and the Forest Service. Although it is of a reconnaissance nature, it has been checked with the U. S. Census of Agriculture data and other sources. These data are used throughout this report.

FACTORS THAT IMPROVE FEASIBILITY

A field reconnaissance and an evaluation of available data for each watershed were made to obtain additional information on opportunities for P. L. 566 action based upon watershed area, physiographic conditions, land use, water yield and its seasonal distribution, and water-related problems and needs. Some of this material is limited because of lack of time for making more detailed field observation; however, many of the water-related problems of the Powder Drainage Basin could be reduced or solved under

P. L. 566. Under existing conditions and laws, it appears that a solution of these problems may be practicable and feasible in several watersheds. The Survey Staff's findings indicate that watersheds with best possibilities for P. L. 566 action have a combination of some of the following conditions:

1. Most of the watershed lies at low elevation and has relatively low summer water yields.
2. The watershed contains highly erodible soils that are subject to action from wind and/or water.
3. The watershed has, or has potential for, a high degree of agricultural, residential, or urban development.
4. The watershed has a large area suitable for irrigation development and lacks water sources that can be developed by individual farmers but has water sources that can be developed by group action.
5. The watershed has localized flooding and/or drainage problems which are related to floods of moderate duration.
6. The watershed contains one or more storage sites which appear feasible for multipurpose development.

FACTORS THAT LIMIT FEASIBILITY

Some watersheds studied do not appear to be suitable for P. L. 566 action. These watersheds usually have a combination of some of the following conditions:

1. The watershed has high water yield and large peak flows which produce flooding and drainage problems that are beyond the scope of P. L. 566.
2. Most of the watershed needs are for land treatment on forest and range lands where there is little present economic incentive for land treatment measures.
3. Only a small part of the watershed that would benefit materially from flood protection and drainage is under agricultural, residential, or urban uses, and there is limited potential for expansion of these land uses.
4. The watershed has minor drainage, flooding, and water supply problems that can best be solved through individual action.
5. Group irrigation development is not feasible in the watershed because of land capability factors or insufficient water supply.

FACTORS THAT COULD CHANGE FEASIBILITY IN THE FUTURE

There are several factors that may affect the future feasibility of a given watershed for P. L. 566 action:

1. Revision of P. L. 566 to provide greater Federal contribution for land treatment, flood control, recreation, and fish and wildlife benefits.
2. Increased demands for water arising from urbanization, industrialization, and demand for specialized agricultural crops

may improve the need for P. L. 566 action in some watersheds.

3. Small watershed projects may be feasible in some areas adjacent to, or part of, planned Bureau of Reclamation projects. Such small watershed projects could be complementary to a larger project.
4. The degree of local interest in a given project will influence the immediate prospects for P. L. 566 action in many watersheds where projects appear to be physically and economically feasible. Interest in irrigation and more intensive land use will be particularly important as many potential projects center around irrigation development.
5. In a few instances, changing the boundaries of an area proposed for small watershed development might improve the possibility for P. L. 566 action. For instance, a watershed with suitable storage sites but small water requirements for irrigation, domestic, or other uses might be combined with an adjacent watershed with large water requirements but no storage potential.
6. Improvements made by individuals or groups in a watershed may reduce future benefits which would affect adversely the possibilities of a P. L. 566 project.

SUMMARY OF REPORTS

Further detailed investigations would be necessary to determine engineering and economic feasibility of a given project. The Survey Staff's findings are presented in individual watershed reports summarized in table 26 and shown on map 8.

Table 26.--Summary of watershed reports, Powder Drainage Basin, Oregon, 1965 1/

Watershed		Project possibilities under P. L. 566
14-3	Oxbow.....	A project does not appear to be feasible under existing conditions and laws.
14-4	Pine Valley.....	An application for assistance under P. L. 566 has been received and approved for planning. A project to develop water for irrigation, fish, and recreation uses, flood protection, channel improvement, and land treatment appears to be feasible.
14-5	Home.....	A project does not appear to be feasible under existing conditions and laws.
14-6	Benson Creek.....	A project to develop water or import water from the Snake River for irrigation, land treatment, and flood protection might be feasible.

Table 26.--Summary of watershed reports, Powder Drainage Basin, Oregon, 1965 1/ (Continued)

	Watershed	Project possibilities under P. L. 566
14u-1	Eagle Valley.....	A project to develop water for irrigation, fish, and recreation, flood protection, channel improvement, and land treatment appears to be feasible.
14u-2	Big Creek.....	An application for assistance under P. L. 566 has been received and approved for planning. A project to develop water for irrigation, fish, and recreation, flood protection, and land treatment appears to be feasible.
14u-3	Lower Powder.....	A project does not appear to be feasible under existing conditions and laws for the entire area, but one might be feasible in some parts.
14u-4	Wolf Creek.....	Authorization for planning a P. L. 566 project has been received. A project for flood protection, water management for irrigation, and recreation and land treatment appears to be feasible.
14u-5	North Powder.....	Authorization for planning a P. L. 566 project has been received. A project for flood protection, water management for irrigation, and recreation and land treatment appears to be feasible.
14u-6	Sumpter Valley....	The Bureau of Reclamation is building a reservoir in this watershed to irrigate parts of the Baker Valley which could store nearly all of the available water. A project does not appear to be feasible.
14u-7	Baker.....	The planned Bureau of Reclamation reservoir in Sumpter Valley would supply water for irrigation needs. A project for flood protection, water management and land treatment appears to be feasible.
14t-1	Durkee Valley.....	A project for flood protection, water management for irrigation and recreation, and land treatment might be feasible.
14t-2	Lower Burnt.....	A project does not appear to be feasible at this time for the entire area, but may be in some portions of the watershed.

Table 26.--Summary of watershed reports, Powder Drainage Basin, Oregon, 1965 1/ (Continued)

Watershed	Project possibilities under P. L. 566
14t-3 Middle Burnt.....	A project does not appear to be feasible under existing conditions and laws.
14t-4 Whitney.....	A project for flood protection, water management for irrigation and recreation, and land treatment might be feasible.
14t-5 Unity.....	A project for flood protection, water management for irrigation and recreation, and land treatment appears to be feasible.

1/ USDA River Basin Survey Staff data.

Watershed 14-3 - Oxbow

Description. The Oxbow watershed contains 101,300 acres in Baker and Wallowa Counties and is in the Eagle Valley and Wallowa Soil and Water Conservation Districts. The principal streams in this watershed are North Pine Creek and eight miles of the lower reaches of Pine Creek, which flows in a northeasterly direction into the Snake River. Numerous small creeks drain directly into the Snake River. The watershed extends from the basin boundary on the north along the Snake River to the confluence of the Powder River and Snake River on the south. Elevations range from 1,600 feet to 7,487 feet on Russel Mountain. Average annual precipitation is 19.6 inches ranging from 10 to 40 inches.

The watershed is a hilly to very steep upland with narrow bands of alluvial soils along the streams. The parent material of the upland soils is a combination of residuum from basic igneous rocks, volcanic ash, and loess. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4). The prominent characteristics and qualities of each soil series are recorded in table 1, page 9.

A reconnaissance survey indicates that 95,600 acres are used for the production of crops and livestock. Of this acreage, 46,800 acres are grazed forest land; 48,700 acres are rangeland; and 100 acres are cropland. All the cropland is irrigated pasture and hay. There are two farms in this watershed.

The forests in this watershed, which cover 46,800 acres, consist of ponderosa pine with a bluebunch wheatgrass understory on the ridges and south slopes. The forest of the wetter draws, bottom lands, and north slopes are primarily associated species.

The range-condition lines coincide with fence lines in the 48,700 acres of rangeland. The parts of the area in fair and good condition appear to have a history of relatively light use which is probably due to a shortage of water for livestock.

Watershed Problems and Needs. Problems in this watershed are limited to slight damage to roads, fences, and small acreages of range due to slides. Several logging operations are in progress but there is no excessive soil disturbance. There does not appear to be any potential for increased development of cropland or irrigated acreages.

Opportunities under P. L. 566. A project does not appear to be feasible under existing conditions and laws.

Watershed 14-4 - Pine Valley

Description. The Pine Valley watershed contains 128,400 acres in Baker and Wallowa Counties and is in the Eagle Valley and Wallowa Soil and Water Conservation Districts. Pine Creek is the largest stream in this watershed. East Pine Creek and Clear Creek are important tributaries. The watershed is about 22 miles long and 10 miles wide. Elevations range from 2,250 feet to 9,555 feet on Red Mountain with most of the agricultural land below 3,200 feet. Average annual precipitation is 27.6 inches ranging from 10 to 58 inches. The average growing season in the agricultural area is 140 days.

The upland soils in the southern section of the watershed were developed from basic igneous rocks and the soils in the Wallowa Mountain area originated from a mixture of acid igneous, basic igneous, and metamorphic rocks. Almost all the soils developed on the alluvial fill of the oval-shaped Pine Valley are well drained. Applegate on the terrace and Langrell on the flood plain are well drained and are well suited for irrigation. A problem of droughtiness and workability exists on the moderately shallow and gravelly phases of Langrell. Approximately 2,500 acres of the flood-plain soils, Robinette and Hershal, are somewhat poorly to poorly drained. They need to be drained to be most productive and they are fairly well suited for irrigation after being drained. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4). The prominent characteristics and qualities of each soil series are recorded in table 1, page 9.

A reconnaissance survey indicates that 119,600 acres are used for the production of crops and livestock. Of this acreage, 55,600 acres are grazed forest land; 46,900 acres are rangeland; and 17,100 acres are cropland. All the cropland is irrigated, with hay and pasture occupying 97 percent of the area. The remaining area is planted to grain and corn or is used for orchards or range. There are 118 farms in this watershed.

Approximately 55,600 acres of this watershed are forested. The forests in portions of this watershed resemble very closely the Douglas-fir types found west of the Cascades. Even the undergrowth resembles the west-side

type with bracken fern growing in openings. Other areas are covered with open ponderosa pine on the south slopes and associated species on the north. The ridges are generally open and grassy.

The range history indicates that too many sheep were grazed on the land too early and too long leaving it in a depleted condition. Now the area is used mainly by cattle and big game. The completion of range improvement projects will increase forage available for game by allowing the transfer of livestock from critical winter game ranges to other areas and will reduce or eliminate the conflict now present.

Watershed Problems and Needs. Approximately 800 acres are flooded on an average of one year in five. About half of this area is forested and suffers minor damage. There are 400 acres of cropland that receive moderate damage from sediment deposition and erosion. There is also some severe streambank erosion along the pasture and cropland. Irrigation diversions and other facilities receive some moderate flood damage from erosion and sedimentation. Roads, bridges, and buildings receive minor damage. Channel improvement and sediment retention dams are needed to reduce these problems.

Estimates show that 2,500 acres of arable land need improved subsurface drainage; this includes closed drains and adequate outlets.

Approximately 2,000 acres of additional land are suitable for irrigation development. Natural streamflow is adequate for early season irrigation but, after the first of July, supplemental water is required. About 12,000 acres of presently irrigated land need supplemental water around the first part of July. Water yield of this watershed appears to be adequate in normal years but storage will be required to insure proper seasonal distribution. Four reservoir sites, with a total storage potential of 10,400 acre feet (map 8, index numbers 20 through 23) were investigated in this watershed. Additional small sites exist on smaller tributaries in the watershed.

The rural domestic water supply depends almost entirely upon ground water and appears to be adequate at the present time. The development of water sources for municipal, industrial, and other nonagricultural water uses is needed.

Opportunities under P. L. 566. An application for assistance under P. L. 566 has been received, and planning approval has been authorized. A project to develop water for irrigation, fish, and recreational uses, flood protection, channel improvement, and land treatment appears to be feasible.

Watershed 14-5 - Home

Description. The Home watershed contains 77,400 acres in Baker County and is in the Eagle Valley and Burnt River Soil and Water Conservation Districts. The watershed includes several small creeks which drain into the Brownlee Reservoir between the Powder River and the Burnt River. The area included is 32 miles long and 6 miles wide. Elevations range from 2,077 feet along the reservoir to 6,138 feet on Sugarloaf Mountain. Average annual precipitation is 12.6 inches.

The watershed is a hilly to very steep upland which has been dissected by streams forming V-shaped valleys with narrow bands of alluvial soils. Along the Snake River, a strip of alluvial soils of varying width was deposited by the river. The upland soils were developed in residuum from bedrock into which varying amounts of loess have been mixed. The residuum is from basic igneous rocks in the north, from metamorphic rocks in the south, and from acid igneous rocks in the Lookout Mountain area. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4). The prominent characteristics and qualities of each soil series are recorded in table 1, page 9.

A reconnaissance survey indicates that 75,400 acres are used for the production of crops and livestock. Of this acreage, 4,000 acres are grazed forest land; 70,800 acres are rangeland; and 600 acres are cropland. About 300 acres of the cropland are irrigated hay, pasture, orchards, grain, and corn. Pasture, hay, and grain are produced on the nonirrigated land. This watershed contains four farms.

Approximately 4,000 acres of this watershed are forested. Ponderosa pine is found on south slopes, and associated species are found on the north slopes and in the draws. Almost all the timber is uncut because of poor access, but the forested area is considered valuable from the standpoint of watershed protection and timber production.

Range conditions are somewhat dependent upon the topography of the area. Poorer conditions are found on the bottom lands and the gentle slopes, while better conditions prevail on the steeper slopes. Some of the land near the breaks of the Snake River was burned over in 1961 but has been reseeded to grass successfully.

Watershed Problems and Needs. Problems in this watershed are minor--about once in ten years approximately 40 acres are flooded because of cloudbursts. Flooding occurs on rangeland and cropland and causes serious erosion to areas of sparsely covered, shallow soils. Because the drainages are quite steep, there is much channel erosion and bank cutting during these storms. Some rill erosion exists on cropland on steeper slopes. In general, a change in land use and land treatment measures would reduce flood and erosion damages. Some minor damage to farm facilities, bridges, and roads is reported.

Approximately 2,500 acres of additional land are suitable for irrigation development. Of this acreage, 96 percent would need stored water while the remaining acreage could be irrigated from natural streamflow. This potential area is adjacent to the Brownlee Reservoir which would be a logical source of water. Supplemental water is also needed for 200 acres of the presently irrigated acreage after the first of August.

Rural domestic water is supplied from springs and appears to be adequate at present.

Opportunities under P. L. 566. A project does not appear to be feasible under existing conditions and laws.

Watershed 14-6 - Benson Creek

Description. The Benson Creek watershed contains 15,900 acres in Baker and Malheur Counties and is in the Burnt River and the Malheur Soil and Water Conservation Districts. Benson Creek, the principal stream, flows in a southeasterly direction from Lost Tom Mountain to the Snake River at Farewell Bend. The watershed area is approximately eight miles long and three miles wide. Elevations range from 2,077 feet to over 4,300 feet. The agricultural area generally lies below 2,400 feet. Average annual precipitation is 12.2 inches. The average growing season in the agricultural area is 180 days.

There are almost equal areas of upland soils and terrace and bottom-land soils. The parent material of the upland soils is a mixture of loess and residuum from basic igneous material and metamorphic rock. The slopes vary from rolling to very steep. The terrace and bottom-land soils are well drained and well suited for irrigation. The terrace soils are nearly level to strongly sloping while the bottom-land soils are nearly level to sloping. The soils in the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4). The prominent characteristics and qualities of each soil series are recorded in table 1, page 9.

A reconnaissance survey indicates that 15,700 acres are used for the production of crops and livestock. Of this acreage, 15,300 acres are rangeland and 400 acres are cropland. About 300 acres of the cropland are irrigated. Hay, pasture, and a small amount of corn are produced on this land. On the nonirrigated cropland, hay, pasture, and grain are produced. There are two farms in this watershed.

There is no forest land in this watershed. The range appears to be improving since the stocking rates were reduced. The north exposures and steeper slopes are in better condition classes. Utilization on the steeper slopes has been generally light to moderate.

Watershed Problems and Needs. Approximately 50 acres, generally along the lower reaches and near the mouth of the creek, receive flooding damage. There is also some channel scouring and streambank erosion and cutting. Erosion is a problem on the steeper rangeland with shallow soils. Needs include some channel straightening and clearance and land treatment measures.

Approximately 4,100 acres of additional land are suitable for irrigation development. This acreage would need an outside water source before development could be completed. Because the land is adjacent to the Snake River, the river should be considered a source. Supplemental water for 100 acres of presently irrigated land is needed about July 1.

Opportunities under P. L. 566. A project to develop water or to import water from the Snake River for irrigation, for land treatment, and for flood protection might be feasible.

Watershed 14u-1 - Eagle Valley

Description. The Eagle Valley watershed contains 204,400 acres in Baker and Union Counties. It lies in the Union, Eagle Valley, Keating, and Burnt River Soil and Water Conservation Districts. Eagle Creek and its tributaries, draining the northern portion of the watershed, originate in the Eagle Cap Wilderness and flow in a southerly direction to the Powder River near Richland. The southern portion is drained by Daly Creek from Big Lookout Mountain northerly to the Brownlee Reservoir south of Richland. It also includes the Powder River from mile 29 to the Brownlee Reservoir. The watershed is about 40 miles long and ranges from 7 to 16 miles in width. Elevations range from 9,595 feet on Eagle Cap, 7,120 feet on Big Lookout Mountain to 2,077 feet along the Brownlee Reservoir. Average annual precipitation is 27 inches with a range of 10 to more than 80 inches. The average growing season in the agricultural area is about 150 days.

The upland soils were developed from acid igneous, basic igneous, and metamorphic rocks. The topography of this area is hilly to very steep. The terrace soils, Baker, Barnard, and Virtue, are nearly level to gently rolling, are well drained, and have hardpans at depths of 12 to 36 inches. They are fairly well to well suited for irrigation. There are problems of cultivation on the shallow phases and of erosion on the steep phases. The two flood-plain soils, Balm and Umapine, are nearly level. Balm soil is poorly drained and is fairly well suited for irrigation after being drained. Umapine is somewhat poorly drained, has drainage and alkalinity problems, and is fairly well suited for irrigation. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4). The prominent characteristics and qualities of each soil series are recorded in table 1, page 15.

A reconnaissance survey indicates that 188,900 acres are used for the production of crops and livestock. Of this acreage, 94,400 acres are grazed forest land; 84,100 acres are rangeland; and 10,400 acres are cropland. About 8,300 acres of the cropland are irrigated, with hay, pasture, corn, and orchards being produced. Also, 2,000 acres of the rangeland are irrigated. Hay and pasture are produced on the nonirrigated cropland. This watershed contains 80 farms.

Approximately 94,400 acres of this watershed are forested. The forests are composed of ponderosa pine on the drier, low elevation sites and associated species on the higher slopes and in the wetter draws. There are several logging operations in progress on the National Forest. These operations have been well planned and are closely supervised to reduce any adverse effects on the watershed.

The major forks of Eagle Creek head in the Eagle Cap Wilderness area where extensive areas of raw granite flake off and sluice out the streams. This is particularly noticeable in Kettle and Little Kettle Creeks.

Because Eagle and East Fork Eagle Creeks provide the main access to the wilderness area, they receive significant recreational use. These streams are good fishing streams with cold, fast, free-flowing water.

Watershed Problems and Needs. Approximately 60 acres of cropland are flooded annually. Damage includes some erosion and sedimentation as well as severe streambank erosion and cutting. Concrete control structures and other irrigation facilities are subjected to severe flood damage. Farm facilities, particularly fences, are damaged from flooding. Bridges are destroyed occasionally and floods menace the main highways. The principal needs for flood protection include channel alignment, bank protection, and shaping and removal of gravel bars.

Estimates show that 1,500 acres of arable land need improved drainage. Subsurface systems with adequate outlets and some land grading are needed.

It is estimated that 3,000 acres of additional land are suitable for irrigation development. Natural streamflow is not adequate for the land presently being irrigated; therefore, storage and/or the development of ground water would be required before additional acreage could be considered. A shortage exists after the first of July on about 6,000 acres now being irrigated. Two reservoir sites, with a storage potential of 3,200 acre feet (map 8, index numbers 18 and 19), have been investigated. Other smaller sites exist which are suitable for individual development. Pumping from the Brownlee Reservoir should also be considered for developing and supplementing irrigation water requirements.

Opportunities under P. L. 566. A project to develop water for irrigation, fish, and recreation, flood protection, channel improvement, and land treatment appears to be feasible. There may be some advantages to planning concurrently with the Big Creek watershed because of the possibility of water exchange between watersheds.

Watershed 14u-2 - Big Creek

Description. The Big Creek watershed contains 155,300 acres in Baker and Union Counties and is in the Keating and Union Soil and Water Conservation Districts. This watershed includes Big Creek and its tributaries, Balm Creek, Goose Creek, and small drainages on the north side of the Powder River from mile 29 upstream to Thief Valley Reservoir. It is about 22 miles long and 12 miles wide. Elevations range from 2,500 feet to 8,653 feet with the major agricultural area below 4,000 feet. Average annual precipitation is 23 inches ranging from 13 to 55 inches in the watershed. The average growing season in the agricultural area is 150 days.

The hilly to very steep upland soil area is covered by soils which were developed from acid igneous, basic igneous, and metamorphic rocks. The terrace soils, Virtue, Baker, and Barnard, are nearly level to gently rolling, are well drained, and have hardpans at depths of 12 to 36 inches. They are fairly well to well suited for irrigation. There are cultivation problems on the shallow phases and erosion problems on the steep phases. Small areas of flood-plain soils occur in the valley bottoms. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4). The prominent characteristics and qualities of each soil series are recorded in table 1, page 9.

A reconnaissance survey indicates that 147,400 acres are used for the production of crops and livestock. Of this acreage, 54,700 acres are grazed forest land; 80,900 acres are rangeland; and 11,800 acres are cropland. About 6,700 acres of the cropland are irrigated hay, pasture, and grain. The non-irrigated cropland produces hay, pasture, and grain. There are 50 farms in the watershed.

Approximately 54,700 acres of this watershed are forested. It heads in the Eagle Cap Wilderness area where most of the ridges are bare, and scattered stands of the true-fir and mountain-hemlock are found in the draws and on some of the north-facing slopes. About midway in the watershed are found open stands of ponderosa pine and grassy ridges and timbered draws. This type gives way to the open-grass and grass-shrub lands in the lower elevations.

There is deep channeling along the drainage ways. An explanation may be that, in the past, this area was heavily used by itinerant sheep bands and was badly depleted which exposed the greater portion of it to severe water erosion.

Watershed Problems and Needs. Estimates show that 350 acres are flooded annually. Flooding occurs, in general, on cropland with minor to moderate damage from streambank cutting and debris and sediment deposition. Irrigation facilities and fences are also damaged by debris and sediment deposition. Erosion from logging on forest land and overgrazing on grazed forest land and rangeland is a problem that needs attention. Roads and bridges are subjected to moderate flood damage.

It has been estimated that 5,000 acres of additional land are suitable for irrigation. Natural streamflow is not adequate for future development. The major problem in this watershed is the lack of irrigation water after July 1. Six reservoir sites with a combined storage potential of 31,350 acre feet (map 8, index numbers 12 through 17) have been investigated on various streams in the watershed. It is reported that the present Balm Creek reservoir site has considerable more potential storage capacity, and that it is feasible to raise the dam. Water to fill this enlarged reservoir could be diverted from West Eagle Creek. At present, a diversion exists from Catherine Creek in the Grande Ronde Basin and an application has been filed requesting additional water to be stored at the site on Beagle Creek.

Opportunities under P. L. 566. An application for assistance under P. L. 566 has been received and approved for planning. A project to develop water for irrigation, fish and recreation, flood protection and land treatment appears to be feasible.

Watershed 14u-3 - Lower Powder

Description. The Lower Powder watershed contains 145,800 acres in Baker and Union Counties and is in the Keating, Baker Valley and Union Soil and Water Conservation Districts. This watershed includes the Lower Powder Valley and Virtue Flats area as outlined on map 8. Average annual precipitation varies from 8 to 15 inches. The average growing season varies from 100 to 140 days.

Acid igneous, basic igneous, and metamorphic rocks have contributed the parent material for the soils of the hilly to very steep upland. The terrace soils, Baker, Virtue, Barnard, Encina, and Nagle, are nearly level to steep and are well drained. Baker, Virtue, and Barnard have hardpans at depths of 12 to 36 inches. Encina on the south slopes and Nagle on the north slopes of terraces overlie gravel substrata at 20 to 32 inches. Baker, Virtue, and Barnard are fairly well to well suited for irrigation; whereas Encina and Nagle are unsuitable. Almost all the flood-plain soils, including Wingville, Stanfield, Baldock, Umapine, Haines, and Balm, are somewhat poorly to poorly drained. They are nearly level and, after being drained, they vary from poorly to well suited for irrigation. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4). The prominent characteristics and qualities of each soil series are recorded in table 1, page 9.

A reconnaissance survey indicates that 141,800 acres are used for the production of either crops or livestock. Of this acreage, 124,100 acres are rangeland and 17,700 acres are cropland. Hay, pasture, and grain are produced on the cropland with 12,100 acres being irrigated. This watershed contains 35 farms.

There is no forest land in this watershed.

In the early days, the rangeland was heavily grazed and, before the introduction of cheatgrass, the area was badly depleted and exposed to erosion. It was also the practice during the old mining days to divert water from several drainages into one ditch to use it for hydraulic mining. The waste water from these operations concentrated in one drainage and would increase the probability of gully formation. The sudden, violent summer storms reduce the chance for the gullies to heal. Large areas of rangeland are covered with cheatgrass and big sagebrush.

Watershed Problems and Needs. Estimates show that 900 acres are flooded one year out of five. In 1965, 1,850 acres were flooded. Cropland received damage from streambank erosion and sediment and debris deposition. Irrigation facilities were severely damaged by erosion and sediment and debris deposition. Flooding also damaged and washed out fences, roads, and bridges. Gullying and sheet erosion are problems created by flooding on rangeland. Channel enlargement, alignment, and clearing are needed to reduce the flooding damage.

Approximately 1,600 acres of arable land need drainage. Subsurface drains, both open and closed, and improved outlets are needed.

It has been estimated that 6,500 acres of additional land are suitable for irrigation. Natural streamflow is not adequate for the land presently irrigated. Storage is needed to supplement the present supply of irrigation water and to develop the potential acreage suitable for irrigation. No reservoir sites were investigated in the watershed but reservoir storage on tributary watersheds could be utilized. Also, some consideration should be given to enlarging Thief Valley reservoir.

Opportunities under P. L. 566. A project does not appear to be feasible under existing conditions and laws for the entire area, but one might be feasible in some parts of the watershed.

Watershed 14u-4 - Wolf Creek

Description. The Wolf Creek watershed contains 106,200 acres in Union County and is in the Union Soil and Water Conservation District. The principal drainages in this watershed are Jimmy Creek, Wolf Creek, and Daly Creek. The Union-Baker County line from the Blue Mountain divide almost to Thief Valley reservoir is the southern boundary. Elevations in the watershed range from 3,100 feet to 7,900 feet with the majority of the cropland under 4,000 feet. Average annual precipitation is 17 inches, ranging from 8 to 50 inches in the watershed. The average growing season in the agricultural area is 120 days.

The hilly to very steep upland soil area is covered by soils developed from acid igneous, basic igneous, and metamorphic rocks. Range forage and timber are produced on these soils. Ladd, Hutchinson, Baker, and Virtue are the terrace soils. All except Ladd have hardpans in the substrata at depths varying from 20 to 36 inches. They are well drained, are on 0 to 12 percent slopes, and are well suited for irrigation. The flood-plain soils are on nearly level slopes and are somewhat poorly to poorly drained except for a very small area of well drained soils. Wingville is neutral to moderately alkaline; Baldock is mildly to strongly alkaline; and Haines, Umapine, and Stanfield are strongly to very strongly alkaline. Wingville is well suited for irrigation. Baldock, Haines, and Umapine are fairly well suited for irrigation after being drained. About 60 percent of Haines and Umapine are in native saltgrass pasture. Stanfield with a calcareous hardpan at an average depth of 20 inches is rated as class VI and is poorly suited for irrigation. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4). The prominent characteristics and qualities of each soil series are recorded in table 1, page 15.

A reconnaissance survey indicates that 78,200 acres are used for the production of either crops or livestock. Of this acreage, 13,000 acres are grazed forest land; 46,000 acres are rangeland; and 19,200 acres are cropland. About 12,200 acres of the cropland are irrigated hay, pasture, and grain. The nonirrigated cropland is mainly grain and summer fallow. There are 115 farms in the watershed.

Approximately 38,200 acres of the watershed are forest land. The western portion is forested with ponderosa pine on the drier south slopes and the associated species of fir-spruce-larch on the wetter north slopes at higher elevations. The southwestern portion was included in the 1960 Anthony Lakes fire. The area has been reseeded and is improving.

The range resource varies from open grass-shrub type to grassy ridges in the forested portion. Because of heavy demand by wildlife and the limited forage, the National Forest is closed to livestock. The range condition is

probably fair to poor with large areas of big sagebrush in the lower watershed.

Watershed Problems and Needs. Estimates show that 200 acres of cropland are flooded annually and that 690 acres are flooded during a one-percent storm. Damage is minor since the land is in hay and pasture. Irrigation facilities and fences receive some damage almost every year.

Approximately 1,100 acres of arable land needs drainage. Subsurface drains, both open and closed, and improved outlets are needed.

It has been estimated the 7,000 acres of additional land are suitable for irrigation. Natural streamflows are adequate for 1,000 acres in the early part of the irrigation season. Storage will be needed to develop the potential irrigable acreage as well as to supplement 12,400 acres of presently irrigated land after early July. Four reservoir sites with a potential storage of 25,250 acre feet (map 8, index numbers 1 through 4) have been thoroughly investigated.

Opportunities under P. L. 566. An application for a P. L. 566 project has been received and accepted. A work plan is being prepared for a project to include flood protection, water management for irrigation and recreation and land treatment. A project on this watershed appears to be feasible.

Watershed 14u-5 - North Powder

Description. The North Powder watershed contains 117,800 acres in Baker County and is in the Baker Valley Soil and Water Conservation District. The principal drainages in this watershed are North Powder River, Muddy Creek, Rock Creek, and Willow Creek. The watershed is bounded by the Union-Baker County line on the north and the Powder River on the east. The drainages originate in the Blue Mountains and along Elkhorn Ridge. Elevations range from 3,300 feet to 9,097 feet with the majority of the cropland below 3,600 feet. Average annual precipitation is 23 inches ranging from 8 to 50 inches. The average growing season is 130 days.

The hilly to very steep upland soil area is covered by soils developed from acid igneous, basic igneous, and metamorphic rocks. Range forage and timber are produced on these soils except for part of the North Powder soil area which produces crops. Ladd, Hutchinson, Baker, and Virtue are the terrace soils. All except Ladd have hardpans in the substrata at depths varying from 20 to 36 inches. They are well drained, are on 0 to 12 percent slopes, and are well suited for irrigation. The flood-plain soils are on nearly level slopes and are somewhat poorly to poorly drained except for the well drained Goodrich. Wingville is neutral to moderately alkaline; Baldock is mildly to strongly alkaline; Haines, Umapine, and Stanfield are strongly to very strongly alkaline; and Goodrich is neutral in reaction. Wingville and Goodrich are well suited for irrigation. Baldock, Haines, and Umapine are fairly well suited for irrigation after being drained. About 60 percent of Haines and Umapine are in native saltgrass pasture. Stanfield with a calcareous hardpan at an average depth of 20 inches is rated as class VI and

is poorly suited for irrigation. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4). The prominent characteristics and qualities for each soil series are recorded in table 1, page 9.

A reconnaissance survey indicates that 71,600 acres are used for the production of crops and livestock. Of this acreage, 16,000 acres are grazed forest land; 18,100 acres are rangeland; and 37,500 acres are cropland. About 32,300 acres of the cropland are irrigated hay, pasture, and grain. The non-irrigated cropland is growing mainly grain and summer fallow. There are 175 farms in the watershed.

Approximately 54,200 acres of the watershed are forested. The forests include all the resource associations from principal forest to alpine. The principal forests consist of ponderosa pine in the lower elevations and on some of the drier south slopes. As the precipitation increases with elevation, the associated species of fir-spruce-larch become more prominent until the upper limit of tree growth is approached. This area, called subalpine, has small, slow-growing fir, hemlock, and whitebark pine. The mountain tops are bare of vegetation and covered with snow most of the year.

A large portion was burned by the Anthony Lakes fire in 1960. The fire and salvage logging scars are healing. The young trees are growing well; and, in a few years, the burn will again be a forest.

The National Forest is closed to livestock grazing and most of the private grazing land is used as wintering grounds for the range herds. The dryland range condition is probably fair to poor.

Watershed Problems and Needs. Estimates show that 235 acres of cropland are flooded annually, and that 700 acres are flooded during a one-percent storm. Half of this area is along the North Powder River. Moderate damage from streambank cutting and debris and sediment deposition occurs along Willow Creek. Irrigation facilities, fences, and road culverts require annual clean-up and repair from debris and sediment deposition.

Approximately 2,300 acres of arable land need drainage. Subsurface drains, both open and closed, and improved outlets are needed.

It has been estimated that 5,200 acres of additional land are suitable for irrigation. Natural streamflows are adequate for 2,000 acres in the early part of the irrigation season. Storage will be needed to develop the potentially irrigable acreage as well as to supplement 31,900 acres of presently irrigated land after early July. Five reservoir sites with a storage potential of 30,000 acre feet (map 8, index numbers 5 through 9) have been investigated.

Opportunities under P. L. 566. An application for a P. L. 566 project has been received and accepted. A work plan is being prepared for a project to include flood protection, water management for irrigation and recreation and land treatment. A project on this watershed appears to be feasible.

Watershed 14u-6 - Sumpter Valley

Description. The Sumpter Valley watershed contains 104,100 acres in Baker County and is in the Baker Valley Soil and Water Conservation District. This watershed includes the upper reaches of the Powder River and its tributaries upstream from the Mason Dam site. Sumpter is the only city in this watershed. The watershed is 19 miles long and about 15 miles wide. Elevations range from 3,900 feet to 8,330 feet with the majority of the cropland below 4,500 feet. Average annual precipitation is 30 inches with an average growing season of 120 days in the agricultural area.

In a large part of the hilly to very steep upland, the soils were developed from metamorphic rocks and the rest were developed from acid igneous and basic igneous rocks. Almost all the terrace soils are the McEwen series. It is formed from old, coarse mixed alluvium from metamorphic and acid igneous rock. McEwen is well drained, neutral in the surface, and is well suited for irrigation. Fourteen hundred acres of placer diggings near Sumpter are class VIII. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4). The prominent characteristics and qualities of each soil series are recorded in table 1, page 9.

A reconnaissance survey indicates that 58,700 acres are used for the production of either crops or livestock. Of this acreage, 51,000 acres are grazed forest land; 4,700 acres are rangeland; and 3,000 acres are cropland. Hay and pasture are produced on the cropland with 2,900 acres being irrigated. There are seven farms in the watershed.

Approximately 85,000 acres, or 82 percent of the watershed, are forested. The major timber type is the associated species of fir-spruce-larch with ponderosa pine on the drier south slopes. This area has a rather long history of logging and much of the pine is young, fairly even aged, and thrifty. There has been some stand improvement (thinning) work on these stands.

Limestone, from a quarry on the north side of the valley, is hauled to the lime plant in the Baker watershed.

Most of the nonforested range in this watershed is in the main valley and is used as winter pasture. The forested range is in generally good condition due to lack of water developments for livestock; however, the portion used as an oldtime sheep driveway is still unvegetated. This area also has a fairly stable population of elk and deer.

Watershed Problems and Needs. Estimates show that 600 acres of pasture are flooded annually. Damage is minor, mainly inundation and some sedimentation. Some gully erosion occurs on cropland and rangeland. Irrigation facilities receive some minor damage from debris and sediment deposition. Damage to roads and bridges is moderate. Some channel improvements and land treatment practices are needed to reduce damages.

Approximately 600 acres of arable land need drainage. Subsurface drainage and improved outlets are needed.

It has been estimated that 2,600 acres of additional land are suitable for irrigation; however, natural streamflow does not appear to be available for this additional acreage because of the Bureau of Reclamation's Baker Valley project. This water will be stored in the Mason Dam which will inundate approximately 2,500 acres of the lower end of the watershed.

Rural domestic water is supplied by springs and is adequate for present needs.

Opportunities under P. L. 566. The Bureau of Reclamation is building a reservoir in this watershed which will store nearly all the available water to irrigate parts of the Baker Valley. The Forest Service is developing recreation facilities adjacent to the lake. A project does not appear to be feasible.

Watershed 14u-7 - Baker

Description. The Baker watershed contains 220,700 acres in Baker County and is in the Baker Valley Soil and Water Conservation District. This watershed includes the Powder River from the proposed Mason Dam site downstream to the city of Haines and the Powder River tributaries. The city of Baker and the area known as Baker Valley are within the bounds of this watershed. The watershed is about 25 miles long and 15 miles wide. Elevations range from 3,300 feet to over 9,000 feet with the majority of the cropland area below 3,500 feet. Average annual precipitation is 16 inches with an average growing season of 167 days in the agricultural area.

The hilly to very steep upland soil area is covered by soils developed from acid igneous, basic igneous, and metamorphic rocks. These soils produce range forage and timber. A considerable area of terrace soils exists in the watershed. Virtue, Baker, Hutchinson, and Salisbury have hardpans in the substrata at depths varying from 20 to 36 inches. Encina and Nagle are underlain with a gravel substratum and Ladd has no restrictive layer. They are well drained, are on 0 to 12 percent slopes, and are well suited for irrigation. The flood-plain soils are on nearly level slopes and vary from well drained to poorly drained. Goodrich is well drained, neutral in the surface soil, and is well suited for irrigation. Powder is moderately well to well drained, is neutral to strongly alkaline, and is well suited for irrigation. Wingville is somewhat poorly to poorly drained, is neutral to moderately alkaline, and is well suited for irrigation. Baldock is somewhat poorly to poorly drained, is mildly to strongly alkaline, and is fairly well suited for irrigation. Haines and Umapine are somewhat poorly to poorly drained, are strongly to very strongly alkaline, and are fairly well suited for irrigation after being drained. About 60 percent of Haines and Umapine are in native saltgrass pasture. Stanfield is somewhat poorly to poorly drained, and is strongly to very strongly alkaline. It has a calcareous hardpan at an average depth of 20 inches, is rated as class VI, and is poorly suited for irrigation. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4). The prominent characteristics and qualities of each soil series are recorded in table 1, page 9.

A reconnaissance survey indicates that 187,200 acres are used for the production of crops and livestock. Of this acreage, 55,700 acres are grazed forest land; 19,100 acres are rangeland, and 52,400 acres are cropland. About 48,200 acres of the cropland are irrigated and produce hay, pasture, and grain. About 2,000 acres of rangeland are being irrigated. The nonirrigated cropland produces hay, pasture, and grain. There are 205 farms in the watershed.

Approximately 66,600 acres of the watershed are forested. Ponderosa pine on the lower lands and associated species on the higher, wetter sites are common. The municipal water supply for Baker comes from this watershed.

The range condition is poor to fair with a slight improving trend. The better condition classes are found on north exposures and steeper slopes. Utilization on the steeper slopes has been light to moderate, but past and present use on much of the area continues to be heavy. Sagebrush areas have been heavily utilized except in areas that are inaccessible to livestock where the desirable species of grass still exist under the sagebrush.

Watershed Problems and Needs. Estimates show that 4,000 acres are flooded annually. Damages range from minor to severe with debris and sediment deposition and streambank erosion being the greatest problems. About half of this area is cropland with damage to crops resulting in loss of production. The remaining acreage is in pasture where bank cutting is the biggest problem. Some moderate sheet and rill erosion occurs on cropland when soil is frozen. There has been severe damage to irrigation facilities from debris and sediment deposition causing breaks and washouts in ditches and canals. The estimated cost of restoration of irrigation facilities was from $10,000 to $15,000 after the 1965 floods. Farm facilities, particularly fences, are damaged from flooding. Roads and bridges are also damaged by debris accumulation and flooding. The principal needs for flood protection include upstream water storage, channel clearing, alignment, and bank protection.

Approximately 14,000 acres of arable land need improved drainage. Subsurface drainage with adequate outlets and some land grading are required. It is estimated that 32,200 acres of additional land are suitable for irrigation development. Natural streamflow is not adequate for the land presently being irrigated; therefore, storage and ground water development will be required to develop the irrigation potential. Estimates show that 2,500 acres can be developed with ground water. The Bureau of Reclamation is constructing the Mason Dam on the Powder River that will provide multiple purpose storage, with irrigation being the principal purpose. One reservoir site with a storage potential of 2,900 acre feet (map 8, index number 11) was investigated in the watershed.

Opportunities under P. L. 566. The planned Bureau of Reclamation reservoir in Sumpter Valley would supply water for irrigation needs. A project for flood protection, water management, and land treatment appears to be feasible.

Watershed 14t-1 - Durkee Valley

Description. The Durkee Valley watershed contains 169,800 acres in Baker County and is in the Burnt River Soil and Water Conservation District. This watershed includes all the drainages into Burnt River from river mile 23, just downstream from Nelson, upstream to river mile 42. The larger drainages include Alder Creek, Pritchard Creek, Durkee Creek, and Manning Creek. It is about 20 miles long and 15 miles wide. Elevations range from 2,600 feet to 7,120 feet with the major agricultural area below 3,600 feet. Average annual precipitation is 14 inches, ranging from 10 to 27 inches. The average growing season in the agricultural area is 160 days.

The hilly to very steep upland soil area is covered by soils developed from acid igneous, basic igneous, and metamorphic rocks. The terrace soils, Baker, Virtue, Encina, and Nagle, are nearly level to steep and are well drained. Baker and Virtue have hardpans at depths of 12 to 36 inches and are fairly well to well suited for irrigation. Encina on the south slopes and Nagle on the north slopes of terraces overlie gravel substrata at 20 to 32 inches and are unsuitable for irrigation. Somewhat poorly to poorly drained alluvial soils formed from mixed materials occupy the bottom lands. They are nearly level to gently sloping and are fairly well to well suited for irrigation. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4). The prominent characteristics and qualities of each soil series are recorded in table 1, page 9.

A reconnaissance survey indicates that 165,600 acres are used for the production of either crops or livestock. Of this acreage, 11,500 acres are grazed forest land; 149,100 acres are rangeland; and 5,000 acres are cropland. About 3,700 acres of cropland are irrigated hay, pasture, and a small acreage of corn. Hay, pasture, and grain are produced on the nonirrigated cropland. There are 25 farms in the watershed.

Approximately 11,500 acres of this watershed are forested. The forests are found in higher elevations where there is more moisture. The largest stands are in the vicinity of Little Lookout Mountain where the pine stands have been cut over at least once. The forested portions are of high value from watershed and timber production standpoints. This is because the blocks of forest are of a manageable size regardless of ownership.

The range appears to be improving after a reduction in the stocking rates. The north exposures and steeper slopes are in the better condition classes. Utilization on the steeper slopes has been generally light to moderate. Some of the rangeland near the streams has been destroyed by placer mining. In addition, the old practice of diverting water for mining left raw gullies which still have not healed.

Watershed Problems and Needs. Estimates show that 200 acres are flooded annually. In general, flooding occurs on cropland along the river and the lower reaches of the larger creeks. Debris and sediment deposition and streambank cutting are the principal problems from flood waters. Erosion is a serious problem on overgrazed rangeland and recently logged forest land.

Flooding is not a major problem to farm and irrigation facilities. There are about 50 miles of roads that receive damage yearly from high water.

Approximately 400 acres of arable land need drainage. Open drains and improved outlets are needed as well as land shaping for improved draining.

It has been estimated that 6,300 acres of additional land are suitable for irrigation. Natural streamflow is adequate for only about 300 acres in the early part of the season. There is a possibility that some ground water could be developed, but the quantity is questionable. Additional water is also needed after the first of July for the land that is presently irrigated. Storage facilities will be required to fully develop the irrigation potential in this watershed. The Bureau of Reclamation has plans for a reservoir at the upper edge of the watershed on Burnt River. There are also four other sites (map 8, index numbers 24 through 27) at various locations in the watershed that have development potential.

Opportunities under P. L. 566. A project for flood protection, water management for irrigation and recreation, and land treatment might be feasible.

Watershed 14t-2 - Lower Burnt River

Description. The Lower Burnt River watershed contains 119,200 acres in Baker and Malheur Counties. It is in the Burnt River Soil and Water Conservation District. This watershed includes all the drainages into the Burnt River from river mile 23 to the confluence of the Burnt River with the Snake River. The largest drainage is Dixie Creek which drains the Rye Valley area. It is 15 miles long and varies from 20 miles to 6 miles in width. Elevations range from 2,100 feet to 7,120 feet with the major agricultural area below 4,000 feet. Average annual precipitation is 14 inches, ranging from 10 to 27 inches. The average growing season in the agricultural area is 180 days.

The watershed is a hilly to very steep upland with V-shaped valleys. The upland soils were developed in residuum from acid igneous, basic igneous, and metamorphic rocks which have been mixed with varying amounts of loess. The alluvial soils are well drained, are neutral to very strongly alkaline, and are fairly well to well suited for irrigation. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4). The prominent characteristics and qualities of each soil series are recorded in table 1, page 9.

A reconnaissance survey indicates that 116,900 acres are used for the production of crops and livestock. Of this acreage, 5,600 acres are grazed forest land; 107,700 acres are rangeland; and 3,600 acres are cropland. About 1,800 acres of cropland are irrigated hay, pasture, and small acreages of corn, orchards, and grain. Hay, pasture, and grain are produced on the non-irrigated cropland. There are 15 farms in the watershed.

Approximately 5,600 acres of this watershed are forested. In addition to the commercial forests at the north and south extremes, there is a significant stand of noncommercial hardwoods on the bottom lands on Dixie and

Shirttail Creeks. The commercial stands consist of ponderosa pine and associated species. Most of them have been cut over at least once, but reproduction is thrifty.

As with other range areas in the Powder Basin, the steeper slopes are in the best condition. It can be noted that cattle can and do graze some of the very steep areas. Better use of management and management facilities could result in more uniform range utilization.

Watershed Problems and Needs. Estimates show that there are only 50 acres flooded. This area is cropland along the river. Debris and sediment deposition is a minor problem while streambank erosion is more severe. Considerable sheet erosion occurs on overgrazed and poor condition rangeland. Moderate to minor damage occurs to irrigation facilities and fences from silting and debris deposits. There is also some minor road damage on Dixie Creek.

It has been estimated that 3,800 acres of additional land are suitable for irrigation. Natural streamflow and ground water are adequate for less than 4 percent of this area. Over 1,300 acres of cropland that is presently irrigated needs supplemental water after July 1. Storage facilities will be required to develop the irrigation potential in the lower areas.

Opportunities under P. L. 566. A project does not appear to be feasible at present for the entire area but may be in some portions of the watershed.

Watershed 14t-3 - Middle Burnt River

Description. The Middle Burnt River watershed contains 127,100 acres in Baker and Malheur Counties and is in the Burnt River and Malheur Soil and Water Conservation Districts. The larger streams of this watershed are Big Creek, Pine Creek, Auburn Creek, Clarks Creek, and the Burnt River from river mile 43 upstream to river mile 75 near Hereford. This reach of the Burnt River flows in an easterly direction through the principal agricultural area of the watershed. Elevations range from 3,300 feet to over 6,600 feet with the major agricultural land below 4,000 feet. Average annual precipitation is 17 inches with an average growing season of 150 days in the agricultural area.

The hilly to very steep upland soil area is covered by soils which were developed in residuum from acid igneous, basic igneous, and metamorphic rocks into which varying amounts of loess have been mixed. The terrace soils, Baker, Virtue, Encina, and Nagle, are nearly level to steep and are well drained. Baker and Virtue have hardpans at depths of 12 to 36 inches, are slightly acid to mildly alkaline, and are fairly well to well suited for irrigation. Encina on the south slopes and Nagle on the north slopes of terraces overlie gravel substrata at 20 to 32 inches and are unsuitable for irrigation. The bottom lands are occupied by somewhat poorly to poorly drained soils formed from mixed alluvium. They are nearly level to gently sloping, are neutral to strongly acid, and are fairly well to well suited for irrigation. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and

extent of each group of soils are shown on the generalized soil map (map 4). The prominent characteristics and qualities of each soil series are recorded in table 1, page 9.

A reconnaissance survey indicates that 121,200 acres are used for the production of crops and livestock. Of this acreage, 55,000 acres are grazed forest land; 61,300 acres are rangeland; and 4,900 acres are cropland. The cropland produces hay, pasture, and grain with 4,800 acres under irrigation. There are 15 farms in this watershed.

Approximately 55,000 acres of this watershed are forested. The forests on the south slopes of Dooley and Bald Mountains were logged in the 1920's. Even though the slopes are steep and there are many roads, the upper watershed is fairly stable. The forest cover is mainly young pine and associated species with an overstory of mature pine.

The range has been used heavily since the 1870's. This overgrazing, coupled with wildfire, has seriously affected the resource. Sagebrush is a major problem, but the Forest Service obtained about 95 percent kill on a spraying project on Bald Mountain. This area will be protected from grazing to allow grass to become established. As is common to almost every range unit in the basin, additional water developments and control fences are needed for good management.

Watershed Problems and Needs. Estimates show that 500 acres of cropland are subject to annual flooding. Flooding generally occurs in early spring along the lower reaches of the river near Bridgeport. Damages range from slight to moderate with debris and sediment deposition being the greatest problem. Flooding causes moderate damage to fences and some minor damage to roads and bridges. Sheet and gully erosion is a problem on recently logged areas and poor condition rangeland.

Approximately 2,000 acres of arable land need drainage. Subsurface drainage, both open drains and tile drains, and improved outlets are needed on the entire acreage.

It has been estimated that 3,000 acres of additional land are suitable for irrigation. Natural streamflow is adequate for about 200 acres. To develop the remaining acreage, storage facilities will be required. One reservoir site (map 8, index number 28) has been investigated. The Dark Canyon site is being planned by the Bureau of Reclamation.

Opportunities under P. L. 566. A project does not appear to be feasible under existing conditions and laws.

Watershed 14t-4 - Whitney

Description. The Whitney watershed contains 103,100 acres in Baker County and is in the Burnt River Soil and Water Conservation District. This watershed includes the North Fork Burnt River and its tributaries. The North Fork Burnt River flows in a southeasterly direction from the area of Greenhorn in the Blue Mountains into Unity Reservoir. The watershed is 24 miles

long and averages 7 miles in width. Elevations range from 3,800 feet to over 7,080 feet with the majority of the cropland below 4,500 feet. Average annual precipitation is 20 inches with an average growing season of 140 days in the agricultural area.

The upland soils were developed in residuum from acid igneous, basic igneous, and metamorphic rocks. These soils are on hilly to very steep slopes and produce range forage and timber. Almost all the terraces are composed of the McEwen soils. McEwen is formed from old coarse mixed alluvium which originated from the rocks of the upland. It is well drained, neutral in the surface, and is well suited for irrigation. A small amount of recent alluvial soils border the streams. They are somewhat poorly to poorly drained, and are well suited for irrigation. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4). The prominent characteristics and qualities of each soil series are recorded in table 1, page 15.

A reconnaissance survey indicates that 82,400 acres are used for the production of crops and livestock. Of this acreage, 68,500 acres are grazed forest land; 10,000 acres are rangeland; and 3,900 acres are cropland. About 3,400 acres of the cropland are irrigated hay, pasture, and grain. The non-irrigated cropland also produces hay, pasture, and grain. There are five farms in the watershed.

Approximately 84,500 acres, or 82 percent of the watershed, are forested. The broad, lower valley is forested with ponderosa pine. Farther up the valley in the vicinity of Whitney, there are terraces covered with young, even-aged ponderosa pine. The terraces were logged during the 1925-1935 period. The upper elevations are covered with associated species. There has been moderate timber harvest with a very good job done near the streams. Placer mining has left its mark on the bottom lands.

This well-timbered forest-range area is a spring-fall migration route for deer and elk. The resource is used heavily by cattle. Part of this range is well fenced but, to get the cattle away from the bottom lands, more fences and water developments are needed.

Watershed Problems and Needs. Estimates show that 150 acres are flooded once in ten years. Damages range from minor to moderate with debris and sediment deposition being the greatest problem. Along some reaches of North Fork Burnt River, bank cutting is quite severe through cropland and rangeland. Flooding causes moderate damage to roads, bridges, and some farm facilities, mainly fences.

Approximately 300 acres of arable land need drainage. Subsurface open drains and improved outlets are needed to improve this problem.

Placer mining in the Greenhorn area has silted the stream in for its entire length. Dredge tailings above Whitney have destroyed the valley bottom.

It has been estimated that 3,500 acres of additional land are suitable for irrigation. Natural streamflow is inadequate to irrigate additional acreage. Storage will be needed to develop this potential as well as to supply supplemental water for 1,600 acres of presently irrigated land after the first of July. Seven reservoir sites (map 8, index numbers 29 through 35) have been investigated by various agencies. These range from 300 acre feet to 20,000 acre feet of storage and the larger ones are suitable for multiple purpose development.

Wells and springs are adequate for supplying the rural domestic water in this watershed.

Opportunities under P. L. 566. A project for flood protection, water management for irrigation and recreation, and land treatment might be feasible.

Watershed 14t-5 - Unity

Description. The Unity watershed contains 177,200 acres in Baker and Malheur Counties and is in the Burnt River and Malheur Soil and Water Conservation Districts. The principal streams in this watershed are West Fork, Middle Fork, and South Fork Burnt River, Job Creek, Camp Creek, Mud Creek, and Rock Creek. The South Fork Burnt River is the largest drainage and flows in a northeasterly direction from the Blue Mountains into Unity Reservoir. The watershed is 21 miles from east to west and averages 13 miles from north to south. Elevations range from 3,500 feet to 7,873 feet with the majority of the agricultural land below 4,500 feet. Average annual precipitation is 18 inches with an average growing season of 140 days in the agricultural area.

In the hilly to very steep uplands, the soil parent material is a mixture of residuum from acid igneous, basic igneous, and metamorphic rocks, and deposits of volcanic ash and loess. Upland soils, Kilmerque, Klicker, Rouen, Hall Ranch, and Tolo, produce timber and range forage. The terrace soils are nearly level to steep and are well drained. They are slightly acid to mildly alkaline, have a hardpan at depths of 12 to 36 inches. These soils are fairly well to well suited for irrigation except for Encina on the south slopes and Nagle on the north slopes of terraces which have a gravel substrata at 20 to 32 inches. The bottom-land soils are somewhat poorly to poorly drained and are formed from mixed alluvium. They are nearly level to gently sloping, are neutral to moderately alkaline, and are fairly well to well suited for irrigation. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4). The prominent characteristics and qualities of each soil series are recorded in table 1, page 15.

A reconnaissance survey indicates that 143,400 acres are used for the production of crops and livestock. Of this acreage, 75,600 acres are grazed forest land; 59,400 acres are rangeland; and 8,400 acres are cropland. About 8,100 acres of the cropland are irrigated hay, pasture, and grain. The non-irrigated cropland also produces hay, pasture, and grain. There are 20 farms in the watershed.

Approximately 105,600 acres of the watershed are forested. The forests are found on the western and southern sections with ponderosa pine on the drier sites and associated species in the draws and the higher elevations. Much of the area has been logged at least once and logging is now in progress in various places throughout the area. Many roads have been built and more are under construction to improve access for protection and management. Most of these roads appear to be well built and should cause a minimum of disturbance to the watershed.

Much of the rangeland is covered with sagebrush, but the potential for good range exists as is shown by the results of the sagebrush spray job in the Whiskey Creek drainage. Since the area was sprayed in 1963, forage production has increased, possibly doubled. Grazing was deferred until this spring (1965).

Watershed Problems and Needs. Estimates show that 2,350 acres are flooded once in five years. Damages to rangeland are minor to moderate with debris and sediment deposition being the greatest problem. Streambank cutting and erosion are quite severe through cropland areas and some rangeland. There is some erosion and cutting from logging operations and skid roads. Flooding causes moderate damage to roads, bridges, and some farm facilities.

Approximately 1,800 acres of arable land need drainage. Subsurface drainage, both open ditches and tile lines, is needed. Some land shaping and improved outlets are also required to reduce drainage problems.

It has been estimated that 3,500 acres of additional land are suitable for irrigation. Natural streamflow is inadequate for additional acreage. Storage will be needed to develop the irrigation potential as well as to supply supplemental water for 5,700 acres of presently irrigated land after the middle of July. Two reservoir sites (map 8, index numbers 36 and 37) have been investigated by various agencies. The largest of these is the Hardman site proposed by the Bureau of Reclamation with a storage capacity of 11,000 acre feet. The Bureau is presently investigating a project in this watershed that would provide the water needed to develop the irrigation potential.

Opportunities under P. L. 566. A project for flood protection, water management for irrigation and recreation, and land treatment appears to be feasible.

MEANS TO ACCOMPLISH NEEDED WORK

PROGRAMS OF USDA

Several agencies with the U. S. Department of Agriculture administer programs that are directly concerned with various aspects of water and related land resources. Many of the Department's activities and programs are, or can be, helpful in the solution of problems and the accomplishment of needed work in the Powder Drainage Basin.

COORDINATION OF USDA PROGRAMS AND OTHER BASIN ACTIVITIES

In general, the forestry and agricultural aspects of water and related land resource problems are often intimately connected with uses of land and water for other purposes such as cities and towns, recreation, navigation, industry, and highways. The degree of relationship varies between geographic areas depending primarily upon the resource base available and pressures upon that base.

The U. S. Department of Agriculture is concerned with all agricultural and forest lands in the basin and is responsible for the administration of the 32 percent of the basin that is in National Forests. The U. S. Department of Interior is responsible for the administration of about 18 percent of the area; therefore, the Federal Government is directly responsible for the administration of approximately 50 percent of the Powder Drainage Basin. The management of this land is an important factor in the economy of the basin and influences the timing of water flows and the quality of water flowing from the upper watersheds.

The Corps of Engineers, U. S. Army under assignment by Congress, is charged with the public civil works program to control, regulate, and improve river and harbor resources, to administer the laws pertaining to the preservation of navigable waters, and to plan, construct, and operate flood control works. Many of the existing and possible future projects under the Corps' jurisdiction affect agricultural lands. Substantial assistance in the solution of basin agricultural problems has and will accrue from the coordination of the Corps' work and that of other interests in the basin.

The Bureau of Reclamation is authorized at the public's request to locate, construct, operate, and maintain works for storage, diversion, and development of waters for the reclamation of arid and semiarid lands in the

Western States. Projects constructed by the Bureau should be coordinated with other land and water developments in the basin.

Private and municipal water developments for power and industrial uses in some instances affect agricultural and forest lands. In many cases, substantial mutual benefits can result from the coordination of projects so as to solve or mitigate existing problems.

From an agricultural standpoint, there is a need for coordination of effort on present and future problems on an individual, group, and project basis. In turn, it is important that agricultural water control and utilization developments recognize to the extent feasible all other land and water uses and values. Such coordination is necessary to secure a reduction instead of a compoundment of mutual problems. Notable coordination has occurred and should be continued. This coordination ranges from informal contacts on individual problems to formal liaison between organizations and agencies on the inter-relationship of major projects.

Future small watershed projects need to be coordinated to insure the inclusion of all feasible features to enhance the use of both the watershed and its waters for all worthwhile purposes. In addition, small watershed projects need to complement other major water projects in the basin and make the best use of improvements provided under other programs.

It is hoped that the information in this report and the data gathered for its preparation will be of assistance to others in future coordination of the water and related land resources in the Powder Drainage Basin.